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# ENVIRONMENTAL ASSESSMENT BOARD



## ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

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VOLUME: 125

DATE: Tuesday, March 31, 1992

BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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ENVIRONMENTAL ASSESSMENT BOARD  
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act,  
R.S.O. 1980, c. 140, as amended, and Regulations  
thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro  
consisting of a program in respect of activities  
associated with meeting future electricity  
requirements in Ontario.

Held on the 5th Floor, 2200  
Yonge Street, Toronto, Ontario,  
on Tuesday, the 31st day of March,  
1992, commencing at 10:00 a.m.


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VOLUME 125  
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B E F O R E :

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DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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<u>FRANK CALVIN KING,</u>	
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1 ---Upon commencing at 10:00 a.m.

2 THE REGISTRAR: Please come to order.

3 This hearing is now in session. Please be seated.

4 THE CHAIRMAN: Mr. Campbell?

5 MR. B. CAMPBELL: Mr. Chairman, I just  
6 thought I should state or advise the Panel of some  
7 advice that I have given my witness panel yesterday.

8 We are continuing to get a flow of  
9 documents from AECL following the hearing yesterday and  
10 again this morning. I want it clear on the record that  
11 I have advised the panel that their obligation is only  
12 to make reasonable efforts to familiarize themselves  
13 with this material as it continues to be produced and  
14 that there is no obligation on them to make Herculean  
15 efforts, including to spend their morning cup of coffee  
16 in their dressing gown pouring over this as opposed to  
17 the morning paper.

18 I have also advised them that if their  
19 schedules do not permit them to familiarize themselves  
20 with the documents that they are perfectly free to say  
21 so and that the onus to provide them in a timely way  
22 rests on the cross-examining counsel, it doesn't place  
23 an obligation on them to stay up all night reading this  
24 stuff.

25 Thank you.

1 THE CHAIRMAN: Well, I don't think I am  
2 going to repeat again what the function of these  
3 documents is.

4 They are not evidence. They are there to  
5 provide the Panel with the witnesses' views on any  
6 opinions that may be expressed in them. If they have  
7 not had an opportunity to study them, then they cannot  
8 be expected to express opinions on them, unless they  
9 are matters which are clearly within their knowledge  
10 quite apart from the document.

11 Now, then, are we ready to go, Mr.  
12 Heintzman?

13 MR. HEINTZMAN: Yes, Mr. Chairman.

14 DAVID WHILLANS,  
15 KURT JOHANSEN,  
16 FRANK CALVIN KING,  
WILLIAM JOHN PENN,  
IAN NICHOL DALY; Resumed.

17 CROSS-EXAMINATION BY MR. HEINTZMAN (Cont'd):

18 Q. Mr. Penn, Mr. Campbell referred us to  
19 an interrogatory yesterday which I believe was given an  
20 exhibit number. It was Interrogatory No. 9.2.115. I  
21 just don't recall the exhibit number that was given to  
22 that.

23 THE REGISTRAR: 520.34.

24 MR. HEINTZMAN: .34. I wonder if Ms.  
25 Findlay could distribute copies of those, and if we

1       could just...

2                   Q.   Do you have a copy of this exhibit  
3       and the two letters attached to it, Mr. Penn and other  
4       members of the panel?

5                   MR. PENN:   A.   Yes, I have, Mr.  
6       Heintzman.

7                   Q.   I take it, Mr. Penn, and through you  
8       to members of the panel, that you were not aware of the  
9       letter from Mr. Eliesen, as he then was Deputy Minister  
10      of Ministry of Energy, dated November 16th, 1990, at or  
11      about the time that letter was written?

12                  A.   I'm not sure, Mr. Heintzman, whether  
13      I have seen this memo before.   I would have to read it  
14      to recall, but I don't --

15                  Q.   Please do so.

16                  A.   Thank you.   I have read the letter  
17      from Mr. Eliesen to Mr. Franklin.

18                  Q.   Yes.   And I take it from your remarks  
19      yesterday that you, and I take it other members of the  
20      panel, were not aware of this letter at or about the  
21      time it was written?

22                  A.   No.   This is the first time I have  
23      read this letter.

24                  Q.   I take it that applies to other  
25      members of the panel unless they indicate otherwise.

1 And similarly, Mr. Franklin's letter a week later, you  
2 weren't aware of that and have just read it now?

3 A. Thank you.

4 Q. I take it you have just learned of  
5 that letter now?

6 A. This particular letter. I was aware  
7 that Mr. Franklin wrote to the government, I didn't  
8 know who, about how we intended to cease work on CANDU  
9 "A" and that we intended, as the government had asked,  
10 to divert capital funds that had previously been  
11 approved by the Board to demand management and energy  
12 efficiency initiatives.

13 Q. I take it that you and other members  
14 of the panel, if we look back at the November 16th  
15 letter, were unaware of or not involved in the decision  
16 that is referred to in the first paragraph or how it  
17 was that such a decision was made even before the  
18 Throne Speech or anything about that process?

19 A. I was not aware of any government  
20 decision prior to the Throne Speech.

21 Q. I take it similarly that you wouldn't  
22 and don't know whether any correspondence or views of  
23 this nature were exchanged between the government and  
24 Ontario Hydro at the time of the 1979, 1980 or 1981  
25 delay or advancement in the Darlington plant?



1 A. Well, as I testified yesterday, I am  
2 almost certain that the decision was made by the board  
3 of directors of Ontario Hydro to make the delays in  
4 1978 and '79 I believe are the dates.

5 Q. '79 and '80.

6 A. '79 and '80, thank you. And given my  
7 long employment with Ontario Hydro, I certainly would  
8 have assumed that there would be some discussion with  
9 the government, but I have no knowledge of it.

10 Q. And similarly whether there was any  
11 such discussion at the time of the Update, you have no  
12 knowledge of whether or not such discussion occurred?

13 A. I have no idea.

14 Q. Then, we were discussing yesterday -  
15 and perhaps Mr. Daly can help us on this - load  
16 following, and there was one document that I wanted you  
17 to identify, and it is at Interrogatory No. 9.24.13,  
18 which is hopefully at tab 16 of the booklet I gave to  
19 you of interrogatories.

20 If 9.24.13 could be marked?

21 THE REGISTRAR: Yes. That will be  
22 520.37.

23 ---EXHIBIT NO. 520.37: Interrogatory No. 9.24.13.

24 MR. HEINTZMAN: Q. And, Mr. Daly,  
25 attached to that interrogatory is a Systems Operating

1 Manual, or description, as I understand it, for nuclear  
2 unit manoeuvring?

3 MR. DALY: A. That is correct.

4 Q. So this is a technical instruction or  
5 description of how you go about manoeuvring the  
6 Pickering and Bruce units; is that correct?

7 [10:11 a.m.]

8 A. That's correct. It's put out by the  
9 power systems operations division and is updated  
10 periodically to reflect the current status of  
11 manoeuvring on nuclear units.

12 Q. And it also, I see, deals in part 8  
13 with manoeuvring the Darlington units as well.

14 A. Correct.

15 Q. Now, we were discussing Interrogatory  
16 No. 9.2.45, which we had marked as Exhibit 520.36, and  
17 that's at tab 2 of the booklet of interrogatory  
18 materials, and we had looked at the two pages of  
19 charts, and what I would like to do is take you to the  
20 two pages of graphs which you made mention of but we  
21 hadn't looked at.

22 When we look at the fourth page of  
23 Exhibit 520.36 we have figure 3A, and that charts, does  
24 it, for us in graphic form the verbal discussion which  
25 we had yesterday, the fact that the Bruce "A" unit, for

1 instance, TUEC cost does not rise as fast as the fossil  
2 units, in this case Nanticoke, that is what it shows us  
3 in graphic form?

4 A. That's correct, looking at the TUEC  
5 comparison which we use for accounting purposes.

6 Q. Yes. And the reason for that, I take  
7 it, is that we can see the fuel, particularly the fuel  
8 component of the fossil alternative which is the  
9 right-hand one in each case, looking at 1988, 1994,  
10 1999 and 2004, we can see the fuel component with the  
11 hatched element is growing relatively quickly in the  
12 fossil alternative?

13 A. That's correct. The CANDU fuel  
14 component is largely inflation-proof.

15 Q. And then in figure 3B the same is  
16 shown in a TUEC comparison in deflated 1988 dollars.

17 A. Correct.

18 Q. Can you just explain what that means  
19 and tell me what the difference between that and a LUEC  
20 is, or is a TUEC in deflated 1988 dollars the same as a  
21 LUEC?

22 A. My understanding of TUEC is it is  
23 just -- on 3B they put them all in constant dollars,  
24 dollars of 1988 as opposed to dollars of the year which  
25 is shown in the top figure.

1 My understanding of LUEC and deflated  
2 TUECs is that they are different. We would normally  
3 use LUECs for system planning decisions but TUECs for  
4 accounting year-by-year decisions.

5 Q. Well, I guess I can understand that.  
6 But it does show us in figure 3B that in constant  
7 deflated 1988 dollars, that the TUEC comparison for  
8 Bruce "A" remains below and gradually gets lower in  
9 comparison to Nanticoke?

10 A. Correct.

11 Q. And in figure 4A and 4B a similar  
12 comparison is shown between Pickering and Lambton,  
13 again showing Pickering "A" both on dollars of the year  
14 and deflated 1988 dollars becoming lower than -- the  
15 Pickering "A" numbers becoming lower and lower in  
16 comparison to the Lambton numbers?

17 A. Correct.

18 Q. I take it that subject to the life of  
19 these units, that one could expect these numbers to  
20 continue on in the same trends further into the future?

21 A. I think to answer that question you  
22 would have to look at the costs associated with life  
23 extension of both options. So it's not immediately  
24 apparent it would continue in that way.

25 Q. Do you know of any study that's been

1 done of that, in particular taking these numbers and  
2 applying the costs of life extension for, say, Lambton?

3 A. I'm not aware of any.

4 MR. PENN: A. I think I am surmising but  
5 I believe this is a subject that will be addressed by  
6 Panel 10.

7 Q. Well, are you, either Mr. Penn or Mr.  
8 Daly, presently aware of any such study?

9 A. I am not personally aware of a study,  
10 no.

11 MR. DALY: A. I am not either.

12 THE CHAIRMAN: It may not be addressed by  
13 Panel 10.

14 MR. PENN: It may not be, sir.

15 MR. HEINTZMAN: Q. So neither of you are  
16 presently aware of any such study?

17 MR. PENN: A. I haven't been involved in  
18 a study, no.

19 Q. Does of the same apply to you, Mr.  
20 Daly?

21 MR. DALY: A. The same applies.

22 DR. CONNELL: May I return to the  
23 previous interrogatory for a moment, just a technical  
24 point.

25 I am looking under tab 16 on page 4,



1 section 4.1 deals with the use of condenser steam  
2 discharge valves. I understand that it is possible to  
3 reject all of the generation at Bruce. Is this the  
4 mechanism that is used for generation projection?

5 MR. DALY: It can be in part but there is  
6 move involved in the generation rejection scheme than  
7 just the condenser steam discharge valves. There is  
8 more electrical equipment and relays, and so on.

9 These condenser steam discharge valves  
10 are used on a more regular basis if we wanted to, say,  
11 manoeuvring power slightly, just say reduce power by  
12 10, 20 per cent, not reject the load totally but just  
13 have a certain amount of steam bypass the turbine, so  
14 we could hold the reactor at, say, 80 per cent and have  
15 the generator at 60 per cent. So this is used in a  
16 much broader sense than just generator rejection.

17 DR. CONNELL: It wouldn't be possible to  
18 reject the entire load by this mechanism or it wouldn't  
19 be desirable.

20 MR. DALY: Not totally. And I think the  
21 limits, the limits are shown here in the table below  
22 which indicates the load reductions available from  
23 CSDVs, and as you can see they go down fairly low but  
24 not totally to zero.

25 DR. CONNELL: Thank you. Sorry to

1 interrupt.

2 MR. HEINTZMAN: Q. Mr. Penn and Mr.  
3 Daly, if you could keep Exhibit 520.36 available,  
4 particularly figures 3A to 4B, and if you could put  
5 your hands on Exhibit 452, which is the Update. Do you  
6 have a copy of that available to you?

7 If you would turn with me to page 13 of  
8 that document, and the top of that page under the  
9 heading Fossil Units Life Extension there is a  
10 discussion about fossil units sharing the uncertainty  
11 about future obsolescence, aging problem and regulatory  
12 requirements for nuclear units, it talks about more  
13 experience with fossil extension. The next paragraph  
14 says:

15 Life extension of fossil units must  
16 consider the feasibility and cost of  
17 maintaining the existing units in  
18 operation, as well as the feasibility and  
19 cost of additional environmental control  
20 equipment needed to anticipate future  
21 environmental regulations.

22 Now, I would like to just focus on the  
23 cost word there. If we look at Exhibit 520.36 and  
24 these figures, it's clear, is it not, that using  
25 nuclear generation will provide a more cost-effective



1 means of providing electricity over fossil units in  
2 2004 and following based upon these charts?  
3 [10:23 a.m.]

4 MR. PENN: A. Well, as I mentioned  
5 yesterday, it is my understanding that when nuclear  
6 power is available that since it has a lower cost it is  
7 used, but in the winter months or in high peak summer  
8 months we are likely, given the outages for nuclear  
9 plant, already using that nuclear as base load.

10 Q. Well, that's correct, but you can  
11 build a new nuclear generating station.

12 What I am anxious to get at is this cost  
13 element of using fossil units in 2004 and following and  
14 extending their life, if that is considered to be an  
15 alternative. And focusing on the cost element alone,  
16 this exhibit shows that it is more cost effective, does  
17 it not, to use nuclear and if necessary manoeuvre  
18 nuclear than it is to use fossil?

19 MR. B. CAMPBELL: Just a minute.

20 Mr. Chairman, I believe that this  
21 comparison that my friend is seeking to draw has been  
22 addressed in Panel 3 between the proper use of TUECs in  
23 that planning sense, which his question is clearly  
24 aimed at, and the evidence has been given,  
25 cross-examined on, and it is clear that TUECs cannot be

1 used for planning purposes.

2 THE CHAIRMAN: That may be so, but I  
3 think the general question about the cost of nuclear  
4 generation and its comparison to other forms of energy  
5 is perfectly proper to ask these witnesses about.

6 MR. B. CAMPBELL: The general question,  
7 Mr. Chairman, I take no objection to.

8 THE CHAIRMAN: If he wants to qualify it,  
9 that is up to him. But I think those questions can be  
10 asked.

11 MR. HEINTZMAN: Q. Can you answer that  
12 question, Mr. Penn or Mr. Daly?

13 MR. PENN: A. Well, I was about to say  
14 that you are getting into planning matters again.

15 But given certain hypothetical situations  
16 these figures would show that nuclear power is lower  
17 cost than fossil, but, again, we are talking about  
18 planning matters and with my general knowledge of that  
19 subject one has to design a system with diversity in it  
20 in order to meet circumstances that come along, and the  
21 characteristics of fossil generation are such that you  
22 can start them up and shut them down very much quicker  
23 than, for example, some hypothetical new nuclear plant.

24 Q. Well, it may be that the planners  
25 will tell us, and I will be waiting with baited breath

1 to hear, that on an overall system basis it is more  
2 cost effective to use fossil in certain circumstances  
3 than nuclear.

4 But based upon this document, this  
5 interrogatory, it is clear that on...I guess the best  
6 word is a standalone basis or a unit-for-unit  
7 comparison it is more cost effective to use nuclear in  
8 2004 and following and manoeuvre if necessary than it  
9 is to use fossil. Isn't that what this document tells  
10 us?

11 A. This document, written in 1988,  
12 certainly does to the period about 2008. But I think  
13 in my testimony yesterday I mentioned that I wasn't  
14 sure, given that this document was published in 1988,  
15 whether it in fact included the long-term projected  
16 coal prices for this period of time we are looking at.

17 Q. Yes. It may be that we will get a  
18 better document that will have new coal pricing, that  
19 will have all of the scrubber and other technology that  
20 would have to be applied to fossil units, and that will  
21 change the number. But based upon this document, the  
22 conclusion that I am arriving at on a unit-by-unit  
23 comparison basis is the correct one, isn't it?

24 A. That is what this document says. And  
25 I did have the opportunity to look at the full document

1 overnight.

2 Q. Yes? And what does that help us  
3 with?

4 A. I note - I note - that these TUECs do  
5 include scrubbers on Lambton and two scrubbers on  
6 Nanticoke.

7 Q. Good.

8 A. Including fossil, including flue gas  
9 conditioning.

10 Q. And where does that come from?

11 A. Well, what you have produced here is  
12 only part of this document, or what has been produced  
13 is only part of this document.

14 Q. So is it referred to in one of these  
15 reports that are referred to on the first page?

16 MR. DALY: A. I believe it is referred  
17 to in the second report.

18 Q. All right. Good. Well, perhaps we  
19 should include the full document as part of the  
20 exhibit, and I will endeavour to do so.

21 THE CHAIRMAN: This I take it was what  
22 was attached to the interrogatory. Was the full  
23 document attached to the interrogatory?

24 MR. B. CAMPBELL: Yes.

25 MR. HEINTZMAN: So I think we should have

1 the full document. I wasn't aware that we didn't have  
2 the full document. So I will supplement everybody's  
3 document to that extent.

4 MR. PENN: The only other comment I would  
5 make, of course, is these graphs are comparing the  
6 existing nuclear system with the existing fossil  
7 system. And that is all it does.

8 MR. HEINTZMAN: Q. Right.

9 MR. PENN: A. It doesn't compare  
10 anything else.

11 Q. No, it is telling us whether it is  
12 cost effective to use a nuclear unit at 80 per cent or  
13 down to 40 per cent in existing station in comparison  
14 with an existing fossil station; right?

15 A. That is quite right.

16 Q. Yes.

17 A. But, as you note on those graphs, the  
18 capital component is relatively small. In other words,  
19 it is a depreciated cost to those years, and that, I  
20 think, is fairly significant if you want to compare it  
21 with new nuclear power.

22 Q. Yes. But, as I think you have  
23 graphically told us, the cost-effectiveness or cost of  
24 using existing nuclear goes down in future years  
25 because we have paid for the plant. Isn't that what



1       you have told us?

2                   A. Yes, and that is the point I am  
3       making here.

4                   Q. Well, we can see the capital  
5       component in these figures on the left-hand side of  
6       each bar chart for nuclear. For instance, it is the  
7       lower box in each case?

8                   A. Quite right.

9                   Q. And if you would turn with me to page  
10      73 of Exhibit 519--

11                  A. Yes?

12                  Q. --that is another way of  
13      representing, I take it, the various components of the  
14      cost of the nuclear plants running out to 2014?

15                  A. Yes, that was a summary of my direct  
16      evidence that the existing nuclear system, including  
17      all units at Darlington, over the period of the  
18      planning horizon.

19                  Q. So if we look out to 2014 we can see  
20      that the cost of producing -- is this at 80 per cent  
21      capacity or do we have to have a capacity for this  
22      calculation?

23                  A. These include the capacity factors  
24      that are part of the Update and are advised by Mr.  
25      Daly's department to our planners for each of the

1 units.

2 Q. So are we using the 80 per cent  
3 figure for the "B" plants and the 75 per cent figure  
4 for the "A" plants, or are we using the target figures?

5 A. We are using the expected figures per  
6 year, given outages to do capital modifications or  
7 retubing of every unit, so that I can't answer your  
8 question directly. It may very well be that on average  
9 that over that long period of time that the numbers are  
10 in the area you mentioned.

11 Q. Well, those are the numbers I heard  
12 in evidence, 80 per cent I think for planning purposes,  
13 at least for the Update purposes for the "B" plants,  
14 and 75 per cent for the "A" stations. Am I not correct  
15 on that?

16 A. That is correct. All I am saying is  
17 that one of the reasons for the variations in the  
18 profile of this graph after the year 1991 is the  
19 variation in capacity factor of the system because  
20 plants are out for repair or maintenance or retubing or  
21 whatever.

22 Q. But in any event, by the time we get  
23 to 2014 you are showing a unit energy cost. This is a  
24 TUEC, is it?

25 A. Yes, it is.



1 Q. So we are using a TUEC at 2014  
2 of...it looks like about 3.5 for the system as of 2014?

3 A. Yes, in 1992 constant dollars.

4 Q. So that that would be an amalgam of  
5 the TUECs for each of the units that would -- that are  
6 there now and will exist as of 2014?

7 A. Correct. It is an accumulation, yes.

8 Q. And you would then have a TUEC, if  
9 you wanted to, for each of those plants that would be  
10 more or less up or down from 3.5?

11 A. Correct.

12 Q. And you could then determine whether  
13 that TUEC was higher or lower at any particular  
14 capacity factor than a fossil unit, correct, in the  
15 same fashion as is done in Exhibit 520.36?

16 A. Would you like to state your question  
17 again, please, in a clear -- more simple fashion?

18 Q. What you have represented here on  
19 page 73 is a TUEC--

20 A. Yes.

21 Q. --in a similar fashion to what we  
22 have in Exhibit 520.36?

23 A. Well, this is for the system, and in  
24 the other interrogatory or exhibit it is for specific  
25 units.

1 Q. Yes.

2 A. Stations, rather.

3 Q. But you could do one, as page 73

4 does, for each individual unit if you wanted to?

5 A. It is theoretically possible, yes.

6 Q. And that is in effect what we have in

7 Exhibit 520.36?

8 A. Yes.

9 Q. So that you could do what you have  
10 done in Exhibit 519, page 73, for individual units and  
11 you could compare it to a fossil unit as of 2014 in a  
12 similar manner to what is done on Exhibit 520.36?

13 A. Yes. And that is not in  
14 contradiction with the point I was trying to make when  
15 we started this discussion, that the capital components  
16 here in the figures 4A and 4B are depreciated  
17 capitalized components of existing fossil stations.

18 Q. I am agreeing with you.

19 A. And I am just pointing out they  
20 reduce with time in exactly the same sense that page 73  
21 shows that when you depreciate capital assets the  
22 overall generation cost reduces.

23 Q. You and I are on exactly the same  
24 wave length. If you could do your exercise on page 73  
25 for any individual plant, then you could compare it in

1 the same way that Exhibit 520.36 does to a fossil  
2 plant - that is where we are - if you wanted to?

3 A. Yes.

4 Q. Yes. And you could similarly do an  
5 analysis of page 73, either per unit or total system,  
6 assuming you were operating some of these nuclear units  
7 at 40 per cent capacity instead of 75 or 80 per cent?

8 A. You could.

9 Q. Yes. But, to your knowledge, no such  
10 analysis was done with respect to the fossil life  
11 extensions that are talked about on page 13 of the  
12 Update?

13 [10:35 a.m.]

14 A. As I testified earlier, I don't know  
15 because I personally wasn't involved.

16 DR. CONNELL: Can I ask, throughout this  
17 discussion have we been assuming that TUEC is congruent  
18 with AUEC?

19 MR. PENN: Yes, we have, sir.

20 DR. CONNELL: There is no difference.

21 MR. PENN: No, it is just another name  
22 for it.

23 I think it is more normal to call it  
24 accounting energy cost.

25 DR. CONNELL: Thank you.

1 MR. PENN: And it was discussed by Mr.  
2 Snelson in Panel 3.

3 MR. HEINTZMAN: What I would like to do  
4 for the next part of the examination is to discuss  
5 CANDU 3, 6 and 9 with you, again I think it will be  
6 mostly Mr. Penn and Mr. Daly.

7 I believe we have handed to you copies of  
8 the materials or the technical data relating to these  
9 units. I am going to ask Ms. Findlay to hand to the  
10 Board the technical outline for CANDU 6, CANDU 3 and  
11 CANDU 9, and ask that they be marked has exhibits.

12 THE REGISTRAR: CANDU 6 was the first  
13 one, Mr. Chairman, that will be No. 546; the next one  
14 which was 9, that will be 547, and the next one 3, is  
15 548.

16 ---EXHIBIT NO. 546: CANDU 6 Technical Outline.

17 ---EXHIBIT NO. 547: CANDU 9 Technical Outline

18 ---EXHIBIT NO. 548: CANDU 3 Technical Outline

19 MR. HEINTZMAN: Q. Perhaps Mr. Penn or  
20 Mr. Daly, we could start with Exhibit 546, which is the  
21 CANDU 6 technical outline. May I take it that you are  
22 familiar with the technical outline of a CANDU 6?

23 MR. PENN: A. Yes, I am.

24 Q. And would you come with me to page --  
25 well, it's figure 1.3-3 and figure 1.3-4.

1 A. Yes, I have that.

2 Q. It's the tenth physical page in from  
3 the front. On the right-hand side we have figure 1.3-4  
4 entitled Nuclear Core System and Steam Generating  
5 Plant, and on the left-hand side figure 1.3-3, Reactor  
6 Building Section.

7 If we look at the right-hand side of the  
8 document to figure 1.3-4 we can see in the middle the  
9 reactor core and the piping going to the two pumps, No.  
10 3, and then from there up to the two generators which  
11 we can see -- or the four generators which we can see  
12 on each side; is that correct?

13 A. That's correct.

14 Q. And basically the same configuration  
15 as you have in your generator stations at Darlington or  
16 Bruce or Pickering?

17 A. Well, the configuration is that that  
18 we have at Darlington. The configuration that we have  
19 at Bruce is different.

20 Q. Same as Darlington then?

21 A. Yes.

22 Q. And if you could come with me to page  
23 2.1-5 - if you could keep your hands on the other  
24 because we will be going back to it - we see there the  
25 CANDU nuclear power system, figure 2.2-4, which is



1 basically identical to that which we could find in  
2 Exhibit 519; would I be correct?

3 A. It seems to me that it is identical.

4 THE CHAIRMAN: As to the schematic in  
5 519?

6 MR. PENN: Yes, sir.

7 MR. HEINTZMAN: Q. Sorry, page 5, it's  
8 compared as page 5 of --

9 MR. PENN: A. My introduction to the  
10 CANDU system.

11 Q. Page 5, could you just look at that,  
12 while we have figure 2.2-4 open from Exhibit 546,  
13 basically identical diagrams in your page 5 of Exhibit  
14 519 and figure 2.2-4 from Exhibit 546?

15 A. Yes.

16 Q. And if we look at figure 2.2-1, do we  
17 see the comparable document to that shown on page 23,  
18 if you look at page 23 of Exhibit 519?

19 A. Yes, apart from the fact that figure  
20 2.2-1 shows a pressurizer.

21 Q. Yes. Is that part of the heat  
22 transfer system?

23 A. Yes, it is.

24 Q. But you just didn't include it on  
25 page 23. It's there but it's not included in the page?

1                   A. Yes. My colleague, Mr. King, points  
2 out that we don't have a pressurizer in Pickering style  
3 reactors.

4                   Q. But you do in Darlington?

5                   A. Yes, we do.

6                   Q. And if we look to page 2.6-1 and look  
7 to your page 22 of Exhibit 519.

8                   THE CHAIRMAN: Hold it a second. I  
9 haven't got 2.6-1. Is it a figure or page?

10                  MR. HEINTZMAN: It's figure 2.6-1, and it  
11 is about two-thirds of the way through Exhibit 546, one  
12 half to two-thirds, right before page 2.1-19.

13                  Q. We have a picture of the fuel bundle  
14 in the CANDU 6 in Exhibit 546 basically identical or in  
15 fact identical to what we have shown on page 22 of  
16 Exhibit 519?

17                  MR. PENN: A. It's the basic 37 element  
18 bundle. I notice that the bearing paths on the two  
19 diagrams are differently located, but I think that's a  
20 detail.

21                  Q. As I understand it, Mr. Penn, and you  
22 may not be able to answer this, you can take the fuel  
23 bundles such as we see on page 22 of Exhibit 519 or  
24 figure 2.6-1, you can put it into a CANDU 6, you can  
25 put it into Pickering, Bruce, Darlington, CANDU 9,



1 every one of these units has exactly the same fuel  
2 bundle and sized pressure tube containers; is that your  
3 understanding?

4 A. Yes.

5 Q. And if we can turn in Exhibit 546, to  
6 the page 2.1-1.

7 MR. B. CAMPBELL: Mr. Heintzman, could  
8 you give the page number again, please?

9 MR. HEINTZMAN: 2.1-1.

10 Q. And there we have paragraph 2.1.1  
11 referring to the reactor assembly, and we are told  
12 how -- the components of the reactor assembly, and it  
13 refers to 300, zircaloy-2 calandria tubes in the  
14 reactor assembly. And I understand that that's the  
15 same number of calandria tubes that are in the  
16 Pickering units.

17 THE CHAIRMAN: I am sorry, did you say  
18 300?

19 MR. HEINTZMAN: 380, I hope I said.

20 THE CHAIRMAN: I thought you said 300.

21 MR. HEINTZMAN: 380, sorry.

22 MR. DALY: It's the same as the Pickering  
23 "B" units.

24 MR. HEINTZMAN: Q. It's the same as the  
25 Pickering "B" units.

1 And as we can see in the CANDU 9, it's  
2 480 calandria tubes which I understand is the same as  
3 Darlington?

4 MR. PENN: A. Correct.

5 Q. And we will see in CANDU 3, 233, I  
6 think it is, calandria tubes.

7 So the number of tubes goes up if you are  
8 going to get more power and energy out of the system  
9 and goes down if you are going to get less. Is that  
10 basically what we are involved with here?

11 A. The number of channels are a function  
12 of the output of the reactor, yes.

13 Q. And if you would come with me to  
14 page, I think it is, 4.1-1, there is a discussion of  
15 the safety systems in the CANDU 6, and generically, as  
16 we see in paragraph 4.1 in CANDU it's a description of  
17 that, and when we come over to the shutdown systems on  
18 page 4.1-8, paragraph 4.3.3 describes shutdown system  
19 No. 1, which we can see from the second sentence is a  
20 accomplished by the release of 28 cadmium rods which  
21 fall under gravity from the top of the reactor. That's  
22 the same as the shutdown system No. 1 in the Ontario  
23 Hydro CANDU units?

24 [10:53 a.m.]

25 MR. KING: A. The number of rods change

1 from reactor design to reactor design, but the  
2 principle is the same.

3 Q. And is the number 28 the number in  
4 the Pickering "B" units?

5 A. I believe so. I can check, if you  
6 want.

7 Q. I don't think it is a big deal, but  
8 the system is the same, basically?

9 A. Yes.

10 Q. And then on page 4.1-9 under  
11 paragraph 4.3.4 the second shutdown system is  
12 described, the injection system, and again, that is the  
13 same system that you have in the Ontario Hydro units?

14 A. For all reactors except Pickering  
15 "A".

16 Q. Yes, exactly. So as we discussed  
17 before, Mr. Penn, the real difference, in fact the only  
18 substantial difference, between a CANDU 6 and your  
19 units is the concept of having a standalone building  
20 rather than having a vacuum system attached to the four  
21 units? That is the major difference between the two  
22 systems; is that correct?

23 MR. PENN: A. Well, there are other  
24 differences. For example, the on-power refueling of  
25 CANDU 6, CANDU 3 and 9 is more akin to that in the

1 Pickering-style reactors. The ones in Bruce "A" and  
2 "B" and Darlington have common systems serving each of  
3 the units and is a different system.

4 Q. All right. Other than that do I take  
5 it that the systems are basically identical? The two  
6 differences we have focused on: the vacuum system as  
7 opposed to a standalone, four- to five-building  
8 structure on the one hand, and your description of the  
9 fuel changing systems slightly differently in Bruce and  
10 Darlington?

11 A. Conceptually they are the same.  
12 There are layout differences in the plant.

13 Q. On figure 1.3-6, we have a control  
14 centre plan, and is the control systems similar to  
15 CANDU 6 to the Pickering "B" type of operation or  
16 Bruce?

17 A. Well, I am quite familiar, of course,  
18 with Pickering and Bruce. From what I can see from  
19 this diagram the layout and the displays are similarly  
20 arranged.

21 If Mr. King has any comment on the  
22 difference in the control...

23 MR. KING: A. Well --

24 MR. B. CAMPBELL: I'm sorry. Mr. King  
25 wanted to add something.

1 MR. KING: When you make statements like  
2 are all the control systems the same, when you get down  
3 into the detail, then they are different. If your  
4 question is conceptually are they the same, then the  
5 answer is "yes", but once you get into the detail they  
6 become different.

7 MR. HEINTZMAN: Q. I appreciate that.  
8 Now, if we could look at the next exhibit, and keep  
9 this Exhibit 546 available to you. If we could look to  
10 Exhibit 548 and turn to figure 1.1?

11 THE CHAIRMAN: This is...?

12 MR. HEINTZMAN: 547 is the next one.

13 THE CHAIRMAN: CANDU which?

14 MR. HEINTZMAN: CANDU 9 is the next one,  
15 547.

16 MR. GREENSPOON: We don't have copies of  
17 that, Mr. Chairman.

18 MR. HEINTZMAN: We have given out all we  
19 have. We will get some more for you, if we can.

20 THE CHAIRMAN: Which one are we at now?  
21 1.1?

22 MR. HEINTZMAN: 1.1-1.

23 MR. PENN: Yes, I have that.

24 MR. HEINTZMAN: Q. If you could just  
25 look with me at figure 2.2-1 from Exhibit 546, just to



1 compare those two diagrams, figure 1.1-1 from the CANDU  
2 9, Exhibit 547, to figure 2.2-1, for the CANDU 6 in  
3 Exhibit 546?

4 MR. PENN: A. Yes.

5 Q. And what we see from those two pages  
6 is that the system is, practically speaking, identical  
7 except that obviously the CANDU 9 is larger than the  
8 CANDU 6?

9 A. The arrangement is identical.

10 Q. And if I can find my way to the  
11 next...

12 I want you to turn in Exhibit 546, the  
13 CANDU 6, to the figure we looked at on figure 2.2-4.  
14 My cross-numbering system is letting me down a little,  
15 but we have a similar page in the CANDU 9. We will  
16 come back to that one in a moment.

17 But from your knowledge, the basic system  
18 shown on figure 2.2-4 for the CANDU 6 is identical in a  
19 practical respect to that in CANDU 9 except the CANDU 9  
20 is a larger unit?

21 A. That is my understanding.

22 Q. And if we look in the CANDU 9  
23 document, Exhibit 547, to figure 2.3-1, for the CANDU  
24 9, and compare that to figure 1.3-4 in the CANDU 6,  
25 Exhibit 546, could you get those two to just look at



1       them together: the CANDU 6, Exhibit 546 at figure  
2       1.3-4, and Exhibit 547 for the CANDU 9 at figure 2.3-1?

3               A. Yes.

4               Q. Again, we can see the reactor core in  
5       the centre, the four steam generators on either side,  
6       the pumps and the basic layout of the system is for all  
7       practical purposes the same for the CANDU 9 as the  
8       CANDU 6?

9               A. That is correct.

10              MR. KING: A. I would note that that  
11       comment I think refers primarily to the heat transport  
12       system, the steam generators and the pumps. If you  
13       look at these figures and get down into the some of the  
14       auxiliary systems there are some differences in the  
15       layout.

16              Q. Yes. If you would keep Exhibit 546  
17       where you are so that we can look at the figure on the  
18       left-hand side, figure 1.3-1, and compare that to the  
19       reactor building section in the CANDU 9, Exhibit 547 at  
20       figure 2.2-2, again we are looking at it now from the  
21       side. We can see --

22              THE CHAIRMAN: Hold it. 2?

23              MR. HEINTZMAN: 2.2-2 in Exhibit 547.

24              THE CHAIRMAN: And you want me to compare  
25       it to figure 1.3.1?

1 MR. HEINTZMAN: 1.3-3.

2 THE CHAIRMAN: Oh.

3 MR. HEINTZMAN: In Exhibit 546.

4 Q. We can see again the reactor in the  
5 middle, at the bottom, in both cases on either side the  
6 fueling machine, and then the tube, but we can't see  
7 the one behind it or the ones behind it, the steam  
8 generators, the crane in the middle. Basically the  
9 same layout for the two systems?

10 MR. PENN: A. The basic arrangement of  
11 the main components are several.

12 Q. Yes. And I understand that the real  
13 difference in the CANDU 9 is that if you look at the  
14 CANDU 6 building section you can see that there are  
15 various transmitter rooms and separations because the  
16 unit is built on-site, whereas if you look at the CANDU  
17 9 building section you can see that the building is  
18 built in such a way that you can lower things directly  
19 down through the various channels right throughout the  
20 building, and that is in fact how the design is  
21 provided for, that you just lower the equipment already  
22 constructed right into the building straight down  
23 through the building in components.

24 That is the whole idea of the CANDU 9 and  
25 CANDU 3 design?

1                   A. Yes. As I noted earlier, the layout  
2 of CANDU 3 and 9 and its arrangement is designed for  
3 modularization, which CANDU 6 isn't.

4                   Of course, there are other details  
5 apparent from these figures. The pressure suppression  
6 system in CANDU 6 has a reservoir located in the roof,  
7 whereas the emergency water supply tank in CANDU 9 is a  
8 different arrangement--

9                   Q. Yes.

10                  A. --serving similar purposes.

11                  Q. And I am not sure you can answer this  
12 question, but I understand that for the CANDU 3 and  
13 CANDU 9 the reactor is contained inside a steel tank  
14 which is contained in a concrete room, whereas in the  
15 CANDU 6 the actual tank or containment is concrete  
16 itself? Are you able to confirm that?

17                  Do you understand what I am describing?

18                  MR. KING: A. Yes, I understand that,  
19 and that is correct. CANDU 9 is a shield tank rather  
20 than a concrete vault which contains the biological  
21 water shield.

22                  Q. Yes. And by putting the reactor in a  
23 steel tank and then that being inside the concrete  
24 building, that permits you to proceed in a modular way  
25 by making the steel structure and whatnot and lowering

1       it into the concrete building?

2                   A. Perhaps, Mr. Penn -- I can't talk on  
3 construction techniques.

4                   MR. PENN: A. Well, that is one of the  
5 purposes.

6                   Q. Without going through the balance of  
7 the CANDU 9 Technical Outline, the shutdown systems and  
8 the other technology, while having details that differ,  
9 are substantially the same as the CANDU 6?

10                  A. The major difference, as I understand  
11 it, is the layout of the plant.

12                  Q. Which permits modularization, or one  
13 of the purposes of it is?

14                  A. And enhances safety.

15                  Q. And if we look at the CANDU 9,  
16 Exhibit 547, to page 3-2, and look across at figure  
17 3.3-1, the reactor assembly there, as I understand it -  
18 I think you have told us - is basically the same as in  
19 the CANDU 6, except we now have 480 fuel channels which  
20 we are told at paragraph 3.3.3?

21                  A. CANDU 9 is the Darlington design  
22 reactor.

23                  Q. And Darlington has 480 tubes?

24                  A. Correct.

25                  Q. So basically, the CANDU 9 is a

1       Darlington unit put into a single building  
2       configuration with CANDU 6 upscaled equipment in  
3       effect? Is that a fair way of summarizing what we have  
4       in a CANDU 9?

5                   A. The CANDU 9, as I understand it,  
6       consists of the Darlington reactor with the CANDU 6  
7       Darlington-style, two-loop primary heat transport  
8       system but with layout designed for modularization,  
9       which is key to the designs, and to separate further  
10      safety systems.

11                  Q. Good. Well, let's then deal quickly  
12      with CANDU 3, and if you could look with me at Exhibit  
13      548 and turn with me to figure 1.1-1, and if we can  
14      just have in front of us the CANDU 6 similar page out  
15      of Exhibit 546, figure 2.2-1?

16      [11:15 a.m.]

17                  As I understand the difference in the  
18      CANDU 3 from the CANDU 6 and 9 and which we can see  
19      graphically here is, first of all, there is one fueling  
20      machine, instead of one in each end there is only one,  
21      and the system unloads by the heavy water in the  
22      pressure tubes forcing or pushing the fuel bundle out  
23      of the system?

24                  A. It's what is called a single-ended  
25      fueling concept.



1 Q. And the removal occurs under pressure  
2 as I described it?

3 A. Yes.

4 Q. And similarly, or the other  
5 distinction is, we can see this by looking at the top  
6 of figure 1.1-1, in Exhibit 548, that we have one but  
7 there would be another one behind it, or two steam  
8 generators instead of four as in the CANDU 6 or 9 or  
9 your units?

10 A. Two steam generators and a single  
11 figure of eight loop.

12 THE CHAIRMAN: I'm sorry, you said two  
13 steam generators and what?

14 MR. PENN: The primary heat transport,  
15 circuit, Mr. Chairman, is a single figure of eight, as  
16 opposed to a double figure of eight in the CANDU 6 and  
17 Darlington designs.

18 It is perhaps not obvious from these  
19 diagrams, but it is a figure of eight connected with  
20 inlet and outlet situations.

21 MR. HEINTZMAN: Q. And then if you would  
22 turn with me in Exhibit 548 to figure 3.2-1.

23 MR. PENN: A. 2.3-1?

24 Q. 3.2-1. And if you could have the  
25 CANDU 9 booklet, Exhibit 547, at figure 2.2-2 open so



1 we can compare the CANDU 3 to the CANDU 9. That's  
2 2.2-2 out of Exhibit 547. And what we can see here is  
3 the reactor at the bottom with instead of the four  
4 steam generators, of which we can see 2 in Exhibit 547,  
5 we see in Exhibit 548 the reactor at the bottom with  
6 the one fueling machine on the left-hand side and the  
7 one or in fact two steam generators above that.

8 A. That's correct.

9 Q. And again, the construction is such  
10 that, as we can see, the channels in the building  
11 permit the elements to be lowered into the unit and  
12 then the top put on for modularization purposes?

13 A. That's right.

14 Q. And if you would turn in Exhibit 548,  
15 the CANDU 3, to the next page.

16 THE CHAIRMAN: I am not quite sure what  
17 you mean by modularization.

18 MR. PENN: Well, Mr. Chairman, with all  
19 new developments in the developed world and reactor  
20 technology, and in fact it comes from the shipbuilding  
21 industry originally, the methods of reducing  
22 construction time and cost is to build components in  
23 either factories or on the site in modules. These  
24 modules would contain perhaps the piping, the  
25 electrical wiring, the concrete civil structure, the

1 instrumentation, for one system. And then it is moved  
2 to the site and literally put in place in a module, and  
3 the design of these plants has to be able to  
4 accommodate these modules. Whereas the previous way of  
5 construction literally, in most systems, to build them  
6 from basic principles.

7 So that is what modularization means.  
8 And it started in the shipbuilding industry.

9 MR. HEINTZMAN: Q. If you would turn  
10 with me to Exhibit 548 to page 6-1, perhaps this helps  
11 us understand what modularization is. In paragraph 6.3  
12 the subject is discussed.

13 MR. PENN: A. I am sorry, what was that  
14 page?

15 Q. 6-1 of Exhibit 548. And near the  
16 bottom of the page under paragraph 6.3 the subject of  
17 modularization is discussed. It says it contracts  
18 substantially to cost and schedule reductions on the  
19 CANDU 3, opens up a new dimension of flexibility in  
20 both construction methods and component supply. The  
21 contents of some buildings of a CANDU 3 are subdivided  
22 into modules or system or sub system basis, et cetera.

23 That's what we are discussion there?

24 A. Yes, and I agree with the  
25 description.

1 Q. And then on the next page you will  
2 see, or on page 6-3, the major advantages of  
3 modularization are described as you can have parallel  
4 construction of several modules going on at the same  
5 time, you can have enhanced productivity because you  
6 can actually build these units in the shop rather than  
7 in the field, et cetera.

8 Those are some of the advantages of  
9 modularization?

10 A. Yes, indeed, they are. But of course  
11 while it's been done in the shipbuilding industry and  
12 military concepts, it hasn't yet been completed in a  
13 nuclear power station.

14 Q. On the left-hand side of figure 6.3-1  
15 we are shown modular components that might be put down  
16 into the building in modules; is that correct?

17 A. Yes, indeed. These drawings are  
18 produced by three dimensional computer-assisted  
19 drafting equipment.

20 Q. And in fact, as I understand it, the  
21 whole concept of modularizing has been developed by St.  
22 John's Shipbuilding who are in fact a shipbuilding  
23 company, or have assisted in modularization in these  
24 designs. Are you aware of that?

25 A. Well, they are certainly a source for

1 the Canadian development. There has been developments  
2 in Holland, there has been development in shipbuilding  
3 yards in the New Orleans in the United States, and the  
4 Americans, for example -- and in Japan, at Mitsubishi.  
5 These other countries are using similar technology.

6 Q. So far as the steam generators are  
7 concerned, as I understand it, the same technology  
8 applies for all of these units, including those for  
9 instance at Darlington?

10 A. As far as I know, there is no change  
11 in steam generator technology other than to avoid the  
12 problems we have had at Bruce.

13 Q. Yes. And the same fuel handling  
14 techniques apply in all of the units, your units and  
15 these units, aside from the CANDU 3 operating from only  
16 one side of the reactor?

17 A. Apart from that, these designs are  
18 using a mature on-power refueling method. It's been  
19 developed for 20-odd years.

20 Q. I would just like to have you  
21 identify some of the interrogatories dealing with this  
22 subject. The first is Interrogatory 9.9.4, tab 11,

23 THE REGISTRAR: That will be .38.

24 ---EXHIBIT NO. 520.38: Interrogatory No. 9.9.4.

25 MR. HEINTZMAN: Q. And perhaps you would

1 just like to review that response and confirm that  
2 that's a correct description of the CANDU 3.

3 MR. PENN: A. I can confirm that.

4 Q. Would you turn to the next tab,  
5 please, to Interrogatory No. 9.9.5. If that may have a  
6 number.

7 THE REGISTRAR: 520.39.

8 ---EXHIBIT NO. 520.39: Interrogatory No. 9.9.5.

9 MR. HEINTZMAN: Q. That attaches, Mr.  
10 Penn, the economic cost comparison that was performed  
11 for the CANDU 3 station, and on page 2, in 1989  
12 dollars, as I understand it, Hydro had calculated, for  
13 the purposes of the DSP, a LUEC of 3.7 for a four times  
14 CANDU 3 unit in comparison to the 3.1 LUEC number for  
15 the Darlington type of station expressly referred to in  
16 the DSP.

17 MR. PENN: A. Yes. I note that these  
18 LUECs are for four CANDU 3s. I don't recall the number  
19 sufficiently well to know whether they are on an  
20 existing site or whether they are on a new site.

21 Q. Well, I assumed that they were on an  
22 existing site because the 3.1 LUEC was on an existing  
23 site, because it says they were on a comparative basis.

24 A. Subject to checking.

25 MR. B. CAMPBELL: I think if you look at



1 note 4 on page 2 the matter is covered, Mr. Heintzman.

2 MR. HEINTZMAN: Yes, that's right. Good.

3 MR. PENN: Thank you.

4 MR. HEINTZMAN: Q. Do you know, sir,  
5 whether any such calculation was done either for a  
6 single or multiple units of CANDU 3 for the purpose of  
7 the Update? Are you aware of any such calculation  
8 being done?

9 MR. PENN: A. Well, I am aware of course  
10 that we considered the CANDU 3 in the preliminary  
11 nuclear option review, which was available to the  
12 planners who wrote the Update.

13 Q. Was that prepared before the Update  
14 or was that prepared after the Update?

15 A. The preliminary nuclear option review  
16 was done in two parts, the first part that included all  
17 CANDU options was done in the period ending about  
18 November of last year.

19 THE CHAIRMAN: I'm sorry, I have lost  
20 track. Is that a document that we have?

21 MR. PENN: It's Interrogatory 9.44.2, Mr.  
22 Chairman.

23 MR. HEINTZMAN: Let's turn to that at tab  
24 17. If that could be given an exhibit, Interrogatory  
25 9.44.2.



1 THE REGISTRAR: Previously entered as  
2 520.29.

3 MR. HEINTZMAN: I see, that's already an  
4 exhibit. Tab 17.

5 Q. And if you would come forward to  
6 table 3.1, which is on page 6, you set forth what are  
7 described as proven CANDU options, including a 4 by 881  
8 megawatt Darlington-type unit in three different ways,  
9 either on an existing site, on a new site, or on an  
10 existing site but committing in pairs in three year  
11 intervals.

12 MR. PENN: A. Yes.

13 Q. And then the 516 megawatt times 4  
14 alternative on an existing site, that is a Pickering  
15 type of unit?

16 A. That's correct, Pickering "B"

17 Q. And then one 670 megawatt CANDU 6 on  
18 an existing site or on a new site, and then two CANDU  
19 6s on an existing site, four CANDU 6s on an existing  
20 site, and four CANDU 6s on a new site?

21 A. Correct.

22 Q. All of which were proven CANDU  
23 technologies?

24 A. Yes, being operated.

25 Q. And then on page 9, which you have

1 described as evolutionary CANDU options, referring in  
2 particular to the CANDU 3 and CANDU 9 type of units  
3 that we have been discussing.

4 A. Correct.

5 Q. And one evolutionary light water  
6 reactor also on page 9 being the system 800 plus?

7 A. System 80 plus.

8 Q. System 80 plus, sorry.

9 And all of this was available to the  
10 planners if they had wished to utilize it at the time  
11 of the Update?

12 A. It was fully known to the planners.

13 Q. Yes. Let's look then at page 19.

14 If we can just finish this document, Mr.  
15 Chairman, it would be I think helpful.

16 That was your schedule for commencement  
17 of one of these options if deemed appropriate?

18 A. Well, schedule is an important  
19 characteristic. The purpose of this work was to look  
20 at the characteristics to determine the nature of  
21 flexibility for future options.

22 Q. Yes. And that page, sir, is exactly  
23 the same as page 74 of Exhibit 519. Could you just  
24 look at that to confirm that?

25 A. I could confirm that they are the

1 same.

2 Q. Yes. And then just before we  
3 adjourn, if we would turn to the next two pages in that  
4 interrogatory, now Exhibit 520.29, we have set forth  
5 there as individual LUEC calculations what is set forth  
6 in a different form on page 81 of Exhibit 519.

7 [11:34 a.m.]

8 A. Yes, page 81 of Exhibit 519 covers  
9 all the options in the Preliminary Nuclear Option  
10 Review.

11 Q. And --

12 A. This covers Phase 1, if you wish --  
13 this document known as 9.44.2, interrogatory, that is.  
14 I didn't catch the exhibit number, I'm afraid.

15 Q. Yes, and we are looking at table 4.5  
16 and 4.6 out of that interrogatory, and what we have,  
17 for instance, on option one is an individual LUEC of  
18 3.7 for the 4 times 881 megawatt existing site  
19 configuration?

20 A. That's correct.

21 Q. And that would be one of the elements  
22 on the first line of page 81 of Exhibit 519 because  
23 that line contains both existing site and new site and  
24 contains a little bit more information than the one  
25 line from table 4.5?

1                   A. That's quite correct. The table on  
2 page 81 gives a range of LUEC for a new site and an  
3 existing site for each of the options mentioned here.

4                   Q. So line one on page 81 captures the  
5 first three lines in effect on table 4.5?

6                   A. It does.

7                   Q. Yes. And we didn't have in this  
8 interrogatory, now Exhibit 520.29, any examination of  
9 the non-CANDU alternatives on page 81 other than the  
10 ALWR; do I take that to be correct?

11                  A. The Phase 1 study considered as an  
12 illustrative example of advanced life water reactors  
13 System 80 plus.

14                  As I stated in my direct evidence, that  
15 given the Update to our plan, determined that  
16 in-service for new base load generation was now around  
17 2010, Hydro and I in particular looked at all other  
18 alternatives that may be available to us for that time  
19 period.

20                  Q. That was done after this  
21 interrogatory or the information in this interrogatory  
22 was prepared, the examination of the other  
23 alternatives?

24                  A. Yes, the other alternatives were  
25 looked at from early December until early February,

1 this year.

2 MR. HEINTZMAN: Perhaps that is a  
3 convenient time to break, Mr. Chairman.

4 THE CHAIRMAN: We will break for 15  
5 minutes.

6 THE REGISTRAR: Please come to order.  
7 The hearing will recess for 15 minutes.

8 ---Recess at 11:38 a.m.

9 ---On resuming at 11:56 a.m.

10 THE REGISTRAR: Come to order. This  
11 hearing is again in session. Please be seated.

12 THE CHAIRMAN: Mr. Heintzman?

13 MR. HEINTZMAN: Thank you, Mr. Chairman.

14 Q. Mr. Penn, if we could come back to  
15 you, and page 81 from Exhibit 519, as I understand it,  
16 what has happened within the last several months is  
17 that Ontario Hydro has gone out to each of the major  
18 suppliers of these different technologies and asked  
19 them for something akin to a proposal or proposals  
20 that would result in these kind of units being  
21 constructed?

22 MR. PENN: A. Yes. I and several of my  
23 colleagues visited and consulted with all the major  
24 vendors in the developed world.

25 I didn't ask them for a proposal, but we



1 did have extensive discussions on each of the designs,  
2 as we did with Atomic Energy of Canada Ltd.

3 Q. You got from them fairly firm dollar  
4 numbers as to what they would charge or expect one of  
5 their units to be built for?

6 A. Each vendor has concerns about the  
7 confidentiality of his costs or their costs and  
8 generally regard them as commercial restricted, so we  
9 had base overnight construction costs generally from  
10 the various vendors to which Ontario Hydro added their  
11 own costs and appropriate contingencies in their views.

12 Q. So what you have are dollar numbers  
13 for construction and owners' costs, contingencies, et  
14 cetera, which you have converted then into a LUEC  
15 number on this page?

16 A. Yes.

17 Q. So that you are in a situation where  
18 you have a number of alternatives available to you  
19 which, were it not for the nuclear moratorium, you  
20 could proceed further with?

21 A. We have established, based on current  
22 information, what options are likely to be available  
23 for in-service around 2010, and we have particularly  
24 paid attention to the characteristics of these options.

25 Q. Yes. And before you get to the



1 conceptual or--

2 What is the word you use that starts with  
3 "d"?

4 A. Definition?

5 Q. Right. --definition phase with  
6 respect to any one of these technologies you have to  
7 make a decision as to which one you are going to go  
8 with? I take it that is the process?

9 A. When the time comes to reviewing with  
10 the intention of preparing an environmental assessment,  
11 then Ontario Hydro of course would revisit those  
12 options that would fit the needs of the corporation, of  
13 our province, when we have that type of information  
14 available to us.

15 Q. I am just trying to get the sequence  
16 of events here. The first thing you would have to do  
17 is make a selection of that particular technology you  
18 decide to go with? Would I be correct that that is the  
19 first layer of decision?

20 A. Well, I think the first layer of  
21 decision would be that our planners, based upon the  
22 load growth, and the nature of the impact on the  
23 borrowing, and the impact on rate increases, and the  
24 needs would decide what range of capacity in what  
25 period of time was needed. That would be the starting

1 point.

2 Q. Yes, I am assuming that that would  
3 occur.

4 I am trying to get to your end of the  
5 equation; that is, what will occur in terms of bringing  
6 any of these particular options to fruition? Would I  
7 be correct that once those kinds of considerations are  
8 made, and indeed as part of those, somebody and the  
9 corporation in general has to decide which of these  
10 alternatives you are going to go with? Is that the  
11 first layer of decision at that point?

12 A. I think the quantity of the capacity  
13 that would be needed would be the first thing, and  
14 then, as you can see from page 81 of Exhibit 519, there  
15 are a large range of alternatives from a CANDU 3 that  
16 would provide us with 450 megawatts to as much as four  
17 by 1,356 megawatts or over 5,000 megawatts so that we  
18 would have to decide, are we talking about 450  
19 megawatts, or are we talking about 1,000 megawatts, are  
20 we talking about over a period of time 2,500 megawatts,  
21 in which case it may be four single units.

22 It would be that type of thing. And then  
23 having decided that, then we would have a whole series  
24 of options, and by the time we need to address this  
25 matter seriously, we may have other options.

1 Q. But all right. Are you agreeing with  
2 me, then, one of the first steps is to decide which -  
3 and it may be more than one - you are going to  
4 seriously pursue? That seems to be sort of  
5 fundamental. You have got to decide which of these you  
6 are going to take further.

7 A. We would probably look at several.

8 Q. All right. Then the next stage would  
9 be to advance those, either one or several, into the  
10 concept and definition stages that you have told us  
11 about?

12 A. They would be advanced into the  
13 concept stage to firm up, based on current information  
14 available at the time we started the process, of these  
15 options, yes.

16 Q. And then after the concept phase at  
17 some point you would move into the definition phase?

18 A. Yes. The signal to start the  
19 definition phase is the request from our planners and  
20 confirmed by our board of directors that we should  
21 proceed to put together the environmental assessment  
22 document.

23 Q. And then the final step - and we will  
24 be coming to this - is the construction phase?

25 A. Following all necessary approvals to

1 proceed to commitments, then we would, having prepared  
2 the site - and that is another issue that is subject to  
3 the environmental assessment - have reached the  
4 construction phase, yes.

5 Q. So right now we are at the very front  
6 end of all of that process?

7 A. Yes, we are.

8 Q. Yes. And I want you to look at a  
9 document, not necessarily apropos of that but before we  
10 move on, which I believe you have a single sheet  
11 entitled Ontario Hydro Nuclear Options Review, Phase 2  
12 Study?

13 If that may be marked as the next  
14 exhibit?

15 THE REGISTRAR: Number 549.

16 ---EXHIBIT NO. 549: Single sheet document, entitled  
17 Ontario Hydro Nuclear Options Review,  
18 Phase 2 Study.

18 MR. HEINTZMAN: Q. Do you have it?

19 MR. PENN: A. Yes, I have that.

20 Q. Right. And I understand, sir, that  
21 this document was provided to Ontario Hydro by Atomic  
22 Energy of Canada together with its proposal, or  
23 whatever you would call it, that was given to Ontario  
24 Hydro as part of Ontario Hydro's collection of  
25 information that led to the numbers we have on page 81?

1                   A. Yes. In Phase 1 study we asked to  
2 meet with Atomic Energy of Canada to gain detail of the  
3 design of the CANDU 3, CANDU 9 and the Update of CANDU  
4 6 together with schedules and with basic costs.

5                   Q. Yes. And if you look at the first  
6 line of this document, which has beside it "Phase 1  
7 Study, LUECs, Ontario Hydro Economic Parameters", the  
8 numbers that we see underneath CANDU 3, CANDU 6 and  
9 CANDU 9 are the numbers from your analysis which we  
10 looked at in Exhibit 520.29.

11                   You don't have to look it up but you can,  
12 if you wish, to check the numbers 6.5 for CANDU 3; 5.8,  
13 CANDU 6; and 4.8 for CANDU 9, I believe are the  
14 numbers, that Ontario Hydro came up with.

15                   Would you like to just turn up perhaps  
16 that table 4.5 and 4.6 out of tab 17, which is --

17                   A. That is Exhibit 520.29?

18                   Q. Yes.

19                   A. Yes, thank you.

20                   Q. So you see under CANDU 6 the option  
21 3A, one CANDU 6, existing site, 5.8; CANDU 3, one  
22 existing site, CANDU 3, 6.5; I'm not sure -- CANDU 9,  
23 yes, there it is, option 5A, one CANDU 9, existing  
24 site, 4.8?

25                   A. That is correct.



1 Q. Right. So those were your numbers,  
2 and then Atomic Energy gave to you what they felt those  
3 numbers should be based upon what they felt the proper  
4 economic parameters are, which are footnoted in  
5 footnote 3, being a real interest rate of 4 per cent  
6 versus your interest rate of 11 per cent with 6 per  
7 cent escalation on a capital cost, 5 per cent on  
8 generating costs, equivalent to a 7 per cent real  
9 interest rate?

10 A. Well, I can't personally vouch for  
11 those numbers, but what we would have done is used the  
12 latest forecast from our Economics Division and our  
13 chief economist to determine what the discount rates  
14 and interest rates and escalation would be over the  
15 period of time, the money, the cash flow building these  
16 plants would be.

17 Q. Well, could you check for me and  
18 confirm that your calculations were done on the basis  
19 set forth in footnote 3?

20 MR. B. CAMPBELL: I thought footnote 3  
21 was AECL's calculations.

22 MR. HEINTZMAN: AECL's were on a 4 per  
23 cent real interest rate, and this footnote is telling  
24 us that Ontario Hydro used--

25 MR. B. CAMPBELL: Oh, I'm sorry.



1 MR. HEINTZMAN: -11 per cent interest  
2 rate, 6 per cent escalation on capital costs, a 5 per  
3 cent escalation on generating costs, all of which is  
4 equivalent to a 7 per cent real interest rate.

5 MR. B. CAMPBELL: Mr. Penn, do you know  
6 that now or would you have to check?

7 MR. PENN: I personally can't confirm  
8 that, Mr. Campbell.

9 MR. B. CAMPBELL: If we can't check this  
10 over the break at lunch, then we will take an  
11 undertaking after lunch.

12 MR. HEINTZMAN: May I have a number for  
13 that? Could we do it over lunch?

14 MR. B. CAMPBELL: I think we may be able  
15 to do it over lunch.

16 DR. CONNELL: While that checking is  
17 going on perhaps the author of the numbers could give  
18 us some simple explanation as to why that mix of  
19 variables is equivalent to a 7 per cent real interest  
20 rate. That is not immediately apparent to me.

21 MR. HEINTZMAN: Well, I'm not sure  
22 whether that is AECL's calculation of what, over the  
23 period of the construction, that would work out to be  
24 or whether that is part of Ontario Hydro's calculation.

25 So if it is part of the actual Ontario

1 Hydro analysis, then I would like to know that in  
2 answer to Dr. Connell's question.

3 I assume that either Ontario Hydro or  
4 AECL determined that when you put those amalgam of  
5 interest rates or escalations together over the  
6 lifetime of the proposed project that it works out to a  
7 7 per cent real interest rate.

8 [12:10 p.m.]

9 THE CHAIRMAN: Well, AECL is the author  
10 of this document.

11 MR. HEINTZMAN: Yes.

12 THE CHAIRMAN: And they have represented  
13 that Ontario Hydro has used an 11 per cent interest  
14 rate, a 6 per cent escalation capital cost, and a 5 per  
15 cent escalation generation cost. Then I take it that  
16 the statement equivalent to 7 per cent real interest  
17 rate is the editorial comment of the author, that  
18 that's what that works out to.

19 MR. HEINTZMAN: I am not sure whether  
20 that's the case, or whether Ontario Hydro said that's  
21 equivalent to a 7 per cent real interest rate. That is  
22 my question, I think, to Mr. Penn.

23 MR. PENN: Well, all I can say is I  
24 didn't say it.

25 THE CHAIRMAN: Well, I would think that

1 all Mr. Penn should have to do, or should confirm the  
2 11 per cent interest rate and the 6 per cent escalation  
3 capital and the 5 per cent escalation generation cost.  
4 What that means in real terms is a matter that maybe  
5 will have to be discussed. I don't know. I don't  
6 think Mr. Penn should go any farther than that.

7 MR. HEINTZMAN: If it's their number or  
8 can be verified, I would ask that that occur.

9 MR. B. CAMPBELL: We will check. If in  
10 fact the calculation of the equivalency was conducted  
11 by Ontario Hydro and provided to AECL and then  
12 incorporated into this document, I will try and  
13 determine that over the lunch break. I am not certain  
14 that I can, but I will do my best.

15 THE CHAIRMAN: All right.

16 MR. HEINTZMAN: Q. And real interest  
17 rate means the difference between inflation and current  
18 interest rates. That's what I understand you to mean.

19 MR. PENN: A. That's correct.

20 Q. And I suppose you are not the proper  
21 person for me to suggest that a 7 per cent real  
22 interest rate historically is a very high real interest  
23 rate. That's not in your bailiwick, I would take it,  
24 or is it?

25 A. It's not really, but I have general

1 knowledge. And I would point out that in earlier  
2 cross-examination we were looking at UNIPEDE, figures  
3 of 4 and 8 per cent real interest was looked at.

4 Q. Yes.

5 A. So whether 7 per cent is right or  
6 wrong, it's not extraordinarily high.

7 Q. All right. And then AECL provided  
8 the third line of this document to indicate what I  
9 understand it believed to be the cost of these units,  
10 excluding the owner's costs, and I understand that it  
11 said that on the basis that this is not the first time  
12 unit, but after the first unit this is the cost that it  
13 expects it can deliver a CANDU 9 in the case of 2.49  
14 LUEC, to Atomic Energy for. Is that your  
15 understanding?

16 A. Well, you have said two different  
17 things there.

18 The owner's costs are not whether we are  
19 considering a first of a kind or an nth of a kind of  
20 plant.

21 Just to be helpful, Mr. Chairman, if you  
22 are not sure what I mean by nth of a kind, it's a term  
23 that is usually given in utility, circles to purchasing  
24 a plant that has previously been built and in operation  
25 for, shall we say, more than five plants. And an nth

1 of a kind could be typically be anywhere from five to  
2 ten plants. In other words, you have made a decision  
3 on a plant that has confirmed experience, as opposed to  
4 taking the risk of acquiring the first one.

5 MR. HEINTZMAN: Q. That's what these  
6 numbers, as I understand it, represent the nth of a  
7 kind unit for CANDU 3, CANDU 6 and CANDU 9, is the  
8 third line here?

9 A. Well, yes. And looking at the number  
10 I am ready to accept that. But it also says in the  
11 footnote that it excludes the owner's costs, and the  
12 owner's costs are not insignificant.

13 Q. Absolutely. So if we look under CANDU  
14 9, the first of a kind it is suggested by AECL is going  
15 to be in the vicinity of 3.3, Ontario Hydro's position  
16 is 4.8, and on an nth of a kind it's 2.9 according to  
17 the numbers that AECL has provided to Ontario Hydro?

18 A. Well, in my view you are mixing a few  
19 things up here.

20 The 4.8 is Hydro's view, and I would say  
21 it's a conservative view since we assume the costs were  
22 not nth of a kind. We couldn't assume that by the time  
23 we might build one of these plants there has been 'n'  
24 of them built.

25 Secondly, our value of 4.8 looking at



1 CANDU 9 includes Ontario Hydro's owner's costs, which  
2 means that the preparation of the site, the preparation  
3 of the environmental assessment, the costs of all  
4 approvals, including a hearing such as this, the full  
5 recognition as owner that we are responsible for the  
6 nuclear safety analysis and gaining the licences and  
7 all the building permits, and of course the project  
8 management and a myriad of other things. And of course  
9 then there is the question of a difference in  
10 assumptions on the financial charges that's noted here.

11 And my final comment on this, is that  
12 that I don't know whether we are talking about -- I  
13 assume are talking about single units.

14 Q. Yes.

15 A. I assume we are talking about an  
16 existing site. It doesn't say so on this piece of  
17 paper.

18 Q. Yes.

19 A. And I assume that the contingencies  
20 that are in these numbers are consistent.

21 Q. I am suggesting to you that the  
22 documents -- the proposal, or whatever you want to call  
23 it, that you received from AECL from which you derived  
24 your numbers, includes all of those parameters that you  
25 have just described?



1                   A. Well, I just make the point that it  
2                   is important, if there are differences than clearly we  
3                   are not comparing apples with apples.

4                   Q. Exactly. That's why I am suggesting  
5                   to you that the 3.3 number that you have received from  
6                   AECL is on the same basis as the 4.8 number - I am  
7                   looking at CANDU 9 - except for the difference of  
8                   interest which is set forth in footnote No. 3?

9                   A. That's what the table says, yes.

10                  Q. And would you confirm that for me if  
11                  you are in any doubt about that.

12                  We are going to find out about the  
13                  interest over lunch time, but you are now raising a  
14                  concern as to whether the other parameters that are  
15                  involved in the first two lines are different, and I am  
16                  suggesting to you that they are not and they include  
17                  the same parameters of owner's costs and the other  
18                  elements.

19                  A. Well, I wasn't raising a concern. I  
20                  was merely asking a question whether they were or not.

21                  Q. You received the proposal and you  
22                  incorporated them into page 81.

23                  A. Yes, but I haven't seen the figure  
24                  3.3 before that I can recall.

25                  Q. Well, I suggest that you received

1 that from AECL at the time you received all of the  
2 other material that enabled you to prepare page 81 and  
3 the No. 4.4 and the No. 4.8.

4 Do you want to just confirm that in due  
5 course and let me know whether that's the case?

6 A. Well, it would be helpful if AECL  
7 would perhaps point to the document that I should look  
8 at to confirm it.

9 Q. Did you not receive a complete,  
10 fairly thick - I don't know what you want to call it -  
11 I call it proposal or outline or whatever you want to  
12 call it from AECL?

13 A. I received several documents from  
14 AECL.

15 Q. Yes. Those are the documents to  
16 which I am referring. And this document in fact is  
17 attached to the letter that was delivered to Ontario  
18 Hydro by AECL.

19 MR. B. CAMPBELL: Well, if my friend  
20 could take the opportunity when we break to point to  
21 the particular -- there is an awful lot of paper  
22 floating around right now, including a big pile of  
23 paper that's associated with this 92/1/22 letter. If  
24 my friend could provide us with a little more guidance  
25 at the break, then we can attempt to deal with this

1 question.

2 MR. HEINTZMAN: Certainly.

3 Q. You did receive the data together  
4 with the letter, Mr. Penn?

5 MR. PENN: A. I'm sorry, sir?

6 Q. You did receive the data and the  
7 letter referred to by Mr. Campbell and noted in  
8 footnote No. 1?

9 A. I recognize that letter, yes. But I  
10 don't actually recognize this sheet of paper as being  
11 part of that letter.

12 Q. Well, perhaps your counsel, or we can  
13 sort that out over lunch time. I think this was  
14 attached to the letter.

15 In any event I would like it confirmed at  
16 some point that the first and second lines are on a  
17 consistent basis other than as noted in footnote No. 3  
18 and we will come back to that after Mr. Campbell and I  
19 have looked at the matter.

20 So the difference between lines 1 and 2  
21 and line 3 is that line 3 is nth of a kind and excludes  
22 owner's costs?

23 A. That's what it says, yes.

24 Q. When we look at this document, either  
25 you and your counsel together or you, I would like you

1 to confirm that that's what you understand. I am not  
2 asking you to accept the numbers or the correctness of  
3 them, but just that that's what you understood when you  
4 received this document was being represented to you.  
5 This is what AECL was prepared to say a CANDU 9 could  
6 be built for on a nth of a kind basis.

7 THE CHAIRMAN: I guess it's not entire  
8 clear yet as to whether the document in this form, 549,  
9 was actually received.

10 MR. HEINTZMAN: Yes, it was in this form.

11 MR. PENN: Well, I will certainly check  
12 that. Perhaps my memory is...

13 THE CHAIRMAN: Mr. Penn doesn't remember  
14 it.

15 MR. HEINTZMAN: Perhaps we can all check..

16 MR. B. CAMPBELL: It may well be  
17 received. There is a lot of paper floating around. I  
18 don't think a test that he remember every page...

19 THE CHAIRMAN: Please don't misunderstand  
20 me. I am not in any way critical of that. I just said  
21 that at the moment there is a bit of a gap between the  
22 cross-examiner and the witness in that one says he  
23 never saw this chart before and they are being asked to  
24 confirm the accuracy of it.

25 MR. HEINTZMAN: So we can come back to

1 that after lunch.

2 Q. Now, I would like to leave that  
3 subject matter and turn to one which I think Mr. King  
4 will address.

5 Mr. King, I believe we have given to you  
6 a study entitled Energy for 300 Years: Benefits And  
7 Risks. Do you have that study?

8 MR. KING: A. Yes, I do.

9 MR. HEINTZMAN: If that could be  
10 distributed to the Board. If it's a best seller and  
11 people want more, we will make more.

12 THE CHAIRMAN: Could I have a number for  
13 this document?

14 THE REGISTRAR: This will be No. 550.

15 ---EXHIBIT NO. 550: Document entitled Energy For 300  
16 Years: Benefits and Risks.

17 MR. HEINTZMAN: Q. As I understand it,  
18 Exhibit 550, Mr. King, is a document which will shortly  
19 be a published book by three authors J.S. Nathwani, E.  
20 Siddall and N.C. Lind, to be published by the Institute  
21 for Risk Research at the University of Waterloo.

22 MR. KING: A. That's my understanding.

23 Q. Yes. And Mr. Nathwani is an employee  
24 of Ontario Hydro?

25 A. Yes.



1 Q. And he is in your department?

2 A. Not at this time. When he started  
3 this project approximately three years ago, or got  
4 involved with this project he was a member of our  
5 department.

6 Q. And Mr. Siddall is employed by AECL,  
7 a retired employee?

8 A. He is retired by AECL but he was --  
9 there was some AECL involvement in his work here.

10 Q. And Mr. Lind is a professor of risk  
11 research at the University of Waterloo?

12 A. He is a professor of civil  
13 engineering at the University of Waterloo. He is  
14 associate and previous director of the Institute for  
15 Risk Research at the University.

16 Q. And these three gentlemen have  
17 already published one book which we can buy, and it  
18 deals with the subject of risk in general terms. Are  
19 you familiar with that book?

20 A. I have probably seen it, but I am not  
21 familiar at this time with it.

22 Q. I am told it's called Managing Risk  
23 in the Public Interest, and I had a copy of it but I  
24 didn't bring it with me this morning.

25 Have you heard of that publication?



1                   A. I believe I would have probably had a  
2 copy of it at some point in time. Given that its size  
3 is probably the same as this, I probably guarantee you  
4 that I did not read the whole thing.

5                   Q. And this is the second of their books  
6 now dealing with energy in the context of risk?

7                   A. Yes.

8                   Q. If we turn to the acknowledgement  
9 page, Roman numeral (iii), the second paragraph tells  
10 us that:

11                   This project was undertaken as the  
12 initiative of the authors and the  
13 collaborative effort became possible with  
14 J.S. Nathwani's secondment from Ontario  
15 Hydro to the Institute for Risk Research  
16 for 15 months. He is a member of the  
17 Institute and is appointed an Adjunct  
18 Associate Professor in the Department of  
19 Management Sciences, University of  
20 Waterloo.

21                   So that advises us that Mr. Nathwani was  
22 seconded from Ontario Hydro to the University for this  
23 purpose.

24                   A. There was a request from the  
25 University for a member of Ontario Hydro to participate

1 in this study and he was that person and worked  
2 full-time for a duration of a year or more on this  
3 work.

4 Q. And it tells us then about Mr.  
5 Siddall and about Mr. Lind who is said to be the  
6 founding director of the Institute for Risk Research at  
7 the University of Waterloo.

8 A. Yes.

9 Q. And the acknowledgement concludes  
10 with the words that say that the authors are grateful  
11 for the support from the sponsoring organizations,  
12 which I take it includes Ontario Hydro, we see at top,  
13 AECL, and the Institute, but the results and the  
14 conclusions are the views of the authors.

15 A. Yes.

16 Q. And if we may turn to page Roman  
17 numeral 9, and this is part of the sort of overview or  
18 what is called synopsis starting at page Roman numeral  
19 5, the authors say, in speaking about the various  
20 energy options that they analyze:

21 None of the options for supplying the  
22 needed extra energy presents any  
23 appreciable risk to life or health.  
24 Constraint on energy use or excessive  
25 conservation option, that is, not meeting

1 the demand, would result in the biggest  
2 risk because of the slowing down of the  
3 rate of increase of life expectancy that  
4 can be expected to occur. For all the  
5 options, the loss in life expectancy  
6 (LLE) associated with the risks is much  
7 smaller than the gain in life expectancy  
8 (GLE). The net benefit for provision of  
9 energy supply is shown to be positive by  
10 a large margin.

11 That's one of the overall conclusions of  
12 the authors?

13 A. I believe from my scanning of this  
14 report earlier, that the conclusions are stated very  
15 clearly upfront earlier in the document.

16 Q. Can you take us where you are  
17 referring to?

18 A. To the summary page, third page in at  
19 the bottom of the page.

20 [12:33 p.m.]

21 Q. Is it Roman numeral or...?

22 A. The page before the table of  
23 contents. It is the third page in, including the title  
24 page, title summary.

25 Q. Yes. Yes, and if we look at the

1 conclusions at the bottom of the summary --

2 THE CHAIRMAN: I'm not sure what your  
3 question to the panel is about this. What are you  
4 asking them?

5 MR. HEINTZMAN: I am just trying to get  
6 the basis for the report down, then I am going to ask  
7 Mr. King whether he agrees that this report is a report  
8 which can be relied upon and whether he agrees with  
9 these conclusions.

10 THE CHAIRMAN: All right. Actually, the  
11 conclusions are -- since I now join in the party, on  
12 page 256... [Laughter]

13 MR. HEINTZMAN: You are a fast reader,  
14 Mr. Chairman.

15 256, yes? I was going to take us sort of  
16 step by step because I am a plodder, because the first  
17 thing I wanted to understand was the process which is  
18 to calculate risk in terms of loss or gain in life  
19 expectancy. That seemed to me --

20 MR. B. CAMPBELL: Just a minute. Just a  
21 minute.

22 Mr. Chairman, this tome is apparently the  
23 result of several years' work. It has been provided to  
24 Mr. King last week, as I understand it, together with a  
25 whole bunch of other stuff which he was supposed to

1 read.

2 If my friend's purpose is as he stated  
3 it, to see whether he agrees with the conclusions, it  
4 seems to me that Mr. King, unless he is much more  
5 heroic than even I believe him to be, would need a  
6 substantial period of time measured in weeks and months  
7 rather than weekends in order to be in any position to  
8 reach a sensible conclusion on whether he agrees with  
9 or supports the conclusions reached in this document.

10 In my submission, the question is on its  
11 face so impossible for Mr. King to give any kind of  
12 probative answer to that it should not be permitted and  
13 the examination shouldn't be permitted if that is its  
14 purpose. I think it is just wholly unfair.

15 THE CHAIRMAN: Well, I am looking at page  
16 9, which is what started us all off, page ix, and that  
17 seemed to me just at first glance not to have very much  
18 to do with Mr. King's testimony at this particular  
19 hearing.

20 MR. HEINTZMAN: I am just about to get  
21 into the whole question of risk analysis.

22 THE CHAIRMAN: And I would think that to  
23 get into all the LLE and GLE and all that would require  
24 quite an extensive review of the document itself,  
25 wouldn't it?



1 MR. HEINTZMAN: I intend to try to  
2 discover that in the course of this examination.

3 THE CHAIRMAN: All right. Well, okay.  
4 The better way might be to bring Mr. Lind along when  
5 you have time to put in your case and people then can  
6 ask him questions about what his conclusions are.

7 MR. B. CAMPBELL: That was going to be my  
8 exact point.

9 AECL itself contributed to this work. If  
10 they wish to bring it forward and have it have any  
11 probative value it is my submission that the absolute  
12 worst way to do it is to ask poor Mr. King, who has  
13 been given an unending stack of material to familiarize  
14 himself with, questions -- for instance, this talks  
15 about oil and gas running out and the risk of oil and  
16 gas running out in the foreseeable future. I am not  
17 aware of any of qualifications that Mr. King has in any  
18 risk analysis associated with that.

19 There is a series of questions like that.

20 If my friend wants to attach any  
21 probative value to this at all in my submission AECL  
22 should produce Mr. Siddall. They funded his work. Let  
23 them produce him.

24 In my submission, it is wholly unfair to  
25 put Mr. King in this position. It can have no



1 probative value for the purposes of this hearing and  
2 should simply not be permitted.

3 There has got to be some point at which  
4 evidence is so lacking in probative value that it  
5 should not be permitted to be put on the record, and I  
6 suggest that with this document, with questions  
7 addressed to Mr. King we have exceeded that point.

8 There are some, eventually, rules of  
9 evidence; are there not, Mr. Chairman?

10 MR. HEINTZMAN: One of the most  
11 fundamental rules of evidence is if I intend to put  
12 this document in I am obliged to put the document to  
13 Mr. King and ask him his comments on it.

14 If I showed up in my evidence and tried  
15 to put this document -- if I were Mr. Campbell the  
16 first thing I would do is jump to my feet and said, you  
17 never even asked Mr. King any questions about this  
18 document. So you are obliged under the rules of  
19 evidence to do exactly what I am doing.

20 THE CHAIRMAN: My quarrel is a minor one.  
21 I am not sure that this particular analysis of life  
22 expectancies is something that Mr. King may know very  
23 much about.

24 MR. HEINTZMAN: That is why I started off  
25 with that part of the document--

1 THE CHAIRMAN: All right.

2 MR. HEINTZMAN: --without going to the  
3 conclusions. I was going to go to the methodology and  
4 see if we can get some agreement with the witness that  
5 this is an accepted methodology.

6 THE CHAIRMAN: All right. Well, go ahead  
7 and see how we do.

8 MR. HEINTZMAN: Q. Let's look at page 9,  
9 Mr. King. Is the calculation of risk in accordance  
10 with loss in life expectancy and gain in life  
11 expectancy an accepted method --

12 MR. KING: A. This is Roman numeral 9?

13 Q. Roman numeral 9, yes. Is it an  
14 accepted method for determining risk in relation to  
15 human activity?

16 A. It is one method.

17 Q. Is it one accepted method?

18 A. Well, you would have to determine  
19 accepted by whom.

20 Q. By the community that is involved  
21 with risk assessment. This is one way that is accepted  
22 to calculate risk?

23 A. I have never performed a risk  
24 assessment using this as the consequence parameter.

25 Q. But is it an accepted way amongst the

1 community that performs risk analysis?

2 A. If you look at the literature there  
3 are articles by Mr. Siddall who have proposed this  
4 methodology since the late 1970s, that I am aware of,  
5 and there is probably some other authors, but to  
6 characterize it as 'accepted' I just have no knowledge  
7 to agree with you on that point.

8 Q. You don't know whether it is accepted  
9 or not accepted? Or what are you saying?

10 A. Well, as I said before, what is your  
11 definition of 'the community'. I am saying there may  
12 be some people in that community who will accept this,  
13 but not all people in the community.

14 Q. All right. So that some people in  
15 the risk analysis community accept this as being one of  
16 the bases upon which you can calculate risk? Do I have  
17 it --

18 A. I would agree with that.

19 Q. All right. And this document, if we  
20 turn to page 187, refers to a large number of studies  
21 that have been conducted into, as the table says,  
22 "alternative electricity generating systems" to  
23 determine their risk, as I understand it.

24 A. Well, this is the first time I have  
25 ever seen this table. What it purports to do is list

1 some figures dealing with fatalities per gigawatt per  
2 year. Well, I am not even sure that is per year. It  
3 is GW...

4 If it was per year they should have  
5 another little symbol in there.

6 Q. They have got an "a", "Gwa"?

7 A. Gigawatt years. Fatalities per  
8 gigawatt years.

9 Q. And if we look at - I don't know that  
10 you have it now - Exhibit 507 is one of the documents  
11 that you have referred to, I believe, on several  
12 occasions, which itself seeks to analyze risk; is that  
13 correct?

14 THE CHAIRMAN: 507?

15 MR. HEINTZMAN: 507.

16 MR. KING: I have 507.

17 MR. HEINTZMAN: Q. And that is a  
18 document which seeks to, amongst other things,  
19 determine the risk associated with the nuclear  
20 generation?

21 MR. KING: A. Well, could you point me  
22 to the particular page that you are referring to?

23 Q. Page 5-1.

24 A. Yes?

25 Q. And this document says in the second

1 paragraph on that page:

2 In this way, a risk index is  
3 available. The usual basis for stating  
4 this index is fatalities per gigawatt  
5 year (GWA) of electricity produced.

6 A. I see that, yes.

7 Q. And were you involved in preparing  
8 this document?

9 A. No, I was not.

10 Q. But I take it that members of your  
11 department were?

12 A. That is correct.

13 Q. And is that a correct statement: The  
14 usual basis for stating this index is fatalities per  
15 gigawatt year of electricity produced?

16 A. I assume so, but again, I have not  
17 worked in this area which produces statistics of a  
18 comparative nature from one technology to another.

19 Q. So you are not familiar with this  
20 risk index?

21 A. As I have said, this is an index  
22 which is used, I assume, to compare the risks of one  
23 technology versus the other or plants of a different  
24 size.

25 My involvement has generally been in the



1 risk assessment of a given facility.

2 Q. And if you turn over onto the next  
3 page of the document, 5-2, the report refers to:

4 Health effects of nuclear energy have  
5 been actively analyzed for many years...,  
6 referring to various groups, some of which you can see  
7 in Table 6.1A of Exhibit 550, and it continues:

8 In most of these studies radiological  
9 risk from nuclear power production has  
10 been compared with health risks to the  
11 public from alternative energy sources.

12 Do you see that?

13 A. Yes.

14 Q. Risk assessments are also often  
15 carried out by independent groups  
16 concerned with public health...et cetera,  
17 which I take it would include the World Health  
18 Organization, listed in table 6.1A of Exhibit 550?

19 A. I see that reference to the WHO.

20 Q. So that what we have in Exhibit 550  
21 is the kind of risk analysis which is used to compare  
22 risk of various kinds of generating systems; is it not?

23 A. This is what the authors of this  
24 report have used, yes.

25 Q. Exhibit 507 tells us that that is the

1 basis upon which people assess risk?

2 A. 507 has used the same parameter of  
3 fatalities per gigawatt year as the vehicle for  
4 comparison.

5 Q. Are you telling me that you are just  
6 unfamiliar with this body of learning, comparative risk  
7 analysis between generating systems?

8 A. I am saying I have no personal  
9 working knowledge of that. Just as a reader of  
10 literature.

11 Q. Dr. Whillans, are you familiar with  
12 this body of learning?

13 DR. WHILLANS: A. Probably to about the  
14 same extent as Mr. King, just from reading the  
15 literature.

16 Q. Do you know who prepared the chapter  
17 on risk analysis in Exhibit 507, which I believe was  
18 referred to on several occasions in your examination in  
19 chief?

20 MR. B. CAMPBELL: That particular  
21 chapter?

22 MR. HEINTZMAN: Q. No, no. Exhibit 507.

23 MR. KING: A. Well, I don't believe I  
24 referred to it in my evidence in chief.

25 Q. Well, I believe Exhibit 507 was

1 referred to on several occasions during the evidence in  
2 chief, and I will find out exactly who it was.

3 But maybe Mr. Johansen knows. Do you  
4 have any more familiarity with this area, Mr. Johansen,  
5 than Mr. King or Dr. Whillans?

6 MR. JOHANSEN: A. No, about the same  
7 extent. I might just add in response to your question  
8 about who prepared it, it was prepared by a team of  
9 Ontario Hydro staff.

10 Q. Well, somebody must have had some  
11 expertise in the comparative risk analysis in order to  
12 prepare that part of Exhibit 507 which I have referred  
13 to.

14 A. It is basically a literature review.  
15 There wasn't a great deal of Ontario Hydro analysis.

16 Q. And who did the analysis to the  
17 extent that it was done and did the literature  
18 research?

19 THE CHAIRMAN: You are now talking about  
20 507?

21 MR. HEINTZMAN: Exhibit 507, that area of  
22 507 dealing with risk analysis.

23 MR. JOHANSEN: Well, it was a team  
24 effort, involving staff from the Nuclear Safety  
25 Department, and my own in a coordinating role only, and

1 people from Health and Safety and a number of other  
2 areas.

3 THE CHAIRMAN: But we are referring, Mr.  
4 Johansen, to just those particular passages in Exhibit  
5 507 which Mr. Heintzman referred to.

6 MR. JOHANSEN: Yes.

7 THE CHAIRMAN: Can you give it to me  
8 again?

9 MR. JOHANSEN: Chapter 5.

10 MR. HEINTZMAN: Well, it is the whole of  
11 chapter 5, which is the risk assessment.

12 THE CHAIRMAN: Somebody must have sat  
13 down and written pages 5-1 and 5-2, and what Mr.  
14 Heintzman would like to find out is who did that.

15 MR. JOHANSEN: The coordinating author --  
16 I will put it that way. The coordinating author was a  
17 member of my department.

18 MR. HEINTZMAN: I'm sorry?

19 Q. If you read chapter 5 of Exhibit 507  
20 it starts off with defining what risk is, risk  
21 quantification, and then it takes us on page 5-3 into  
22 occupational hazards, analyses those, using ACN studies  
23 and other studies referred to in Exhibit 550.

24 It goes into public hazards on page 5-7,  
25 again referring to ACNS and other studies that we see

1 in Exhibit 550, radiological risk on page 5-9, public  
2 hazards on page 5-15, discussion of the results of all  
3 of these risks, starting on page 5-21, sets forth  
4 comparison with other studies on page 5-23, including  
5 the UNSCEAR study in 1988, which is referred to in  
6 table 6.1A of Exhibit 550, the Hamilton study - at  
7 least one of Mr. Hamilton's studies is on the same  
8 table - ACNS study, the Fritzsche study, also referred  
9 to in Exhibit 550, and ends up with a large table that  
10 puts this all, or some of them, all together, referring  
11 to the same kind of studies, table 5-1, 5-2, 5-3, 5-4.  
12 [12:50 p.m.]

13 Isn't that doing the same sort of  
14 analysis that these three gentlemen are doing in  
15 Exhibit 550. Can you help me on that, Mr. King or Mr.  
16 Johansen?

17 MR. KING: A. I would think that the  
18 scopes are not the same between the two documents.  
19 There may be some overlap. I wouldn't agree to the  
20 statement that they are just the same analysis.

21 Q. No, no. But Exhibit 507 is doing for  
22 nuclear what Exhibit 550 is seeking to do on a  
23 comparative basis between various generating systems.

24 A. I haven't read 550 through from cover  
25 to cover.



1 Q. I see. Well, could I ask you to do  
2 that?

3 A. In the time frame of months or days?

4 Q. I am content whatever you would like  
5 to do. I will continue after other people have  
6 examined and you have had a chance to read the  
7 document.

8 MR. B. CAMPBELL: Mr. Chairman, with  
9 respect, I think Mr. Mr. King - and I know Dr. Whillans  
10 is anxious to say something - but Mr. King has made it  
11 clear that this is not his area of work.

12 THE CHAIRMAN: Let's move back a bit. I  
13 think that Mr. Heintzman is entitled to know who it is  
14 from Ontario Hydro who should be able to answer  
15 questions relating to the risk chapter in Exhibit 507.  
16 Someone should be able to do that.

17 Now, I don't know which member of the  
18 panel, or if there is anyone on the panel that can do  
19 about that, but somebody should be able to do that.

20 This document 550 is a document that  
21 covers at least some of the same subject matter that  
22 the chapter in 507 does.

23 MS. PATTERSON: Also Hydro seems to have  
24 produced some of its own figures for the tables that  
25 are included in Chapter 5. So someone must have done

1 some original work.

2 MR. B. CAMPBELL: Well, my understanding  
3 was that this had been gathered together, I think as it  
4 says in the forefront, gathered together this work and  
5 whether they were the figures with the block OH under  
6 them are simply the result of literature review or  
7 whether they are original work, I don't know. That  
8 will have to be clarified.

9 Clearly, obviously there were people  
10 associated with the preparation of this document who  
11 were not on the panel, and I will have to inform myself  
12 as to exactly who they are. I think I have a partial  
13 list only.

14 THE CHAIRMAN: My problem is this is a  
15 document, materials relating environmental and health  
16 effects of nuclear generation, I doubt if there a more  
17 important document that is presented to this hearing  
18 and it's an issue that is of vital interest to the  
19 Panel, and if Ontario Hydro puts the document forward  
20 as its evidence on these issues, somebody has got to be  
21 able to answer cross-examination about it, including  
22 comparative literature.

23 MR. B. CAMPBELL: Well, I take your  
24 point, Mr. Chairman. We have Mr. King in front of you  
25 who has clear expertise in nuclear safety matters, Dr.

1 Whillans who has a clear expertise in radiological  
2 health matters, Mr. Johansen has clear expertise in  
3 environmental matters. We can't cover everything with  
4 every panel, and we do not have an expert on this panel  
5 on the topic of this comparative risk analysis  
6 sufficient to do a detailed discussion of Exhibit 550.  
7 I think that is clear.

8 THE CHAIRMAN: I am prepared with a  
9 detailed discussion of 507 to start with. That will  
10 help.

11 MR. B. CAMPBELL: As I say, we have  
12 safety, environmental, health. We have people on this  
13 panel who can speak to all of those matters. The  
14 comparative risk analysis is the aspect in which I  
15 think we do not have at the moment on this panel anyone  
16 who has done detailed work in that area.

17 THE CHAIRMAN: Perhaps we can adjourn now  
18 until 2:30 and you and Mr. Heintzman can work out how  
19 we can proceed from here.

20 MR. HEINTZMAN: Thank you, Mr. Chairman.

21 THE REGISTRAR: Please come to order.  
22 This hearing will adjourn until 2:30.

23 ---Luncheon recess at 1:00 p.m.

24 ---On resuming at 2:33 p.m.

25 THE REGISTRAR: Please come to order.

1 This hearing is again in session. Please be seated.

2 MR. B. CAMPBELL: Thank you, Mr.  
3 Chairman.

4 There are two matters which I undertook  
5 to deal with over the lunch hour. The first one is  
6 Exhibit 549, this table that was produced by Mr.  
7 Heintzman. Mr. Penn can deal with - I think he had the  
8 opportunity to find this over the lunch hour - I think  
9 he can deal with questions relating to the differences  
10 in the Phase 1 study results which, as I understand it,  
11 is the outstanding area of inquiry here.

12 I should just advise the Board that while  
13 this table was provided to Ontario Hydro, it was not  
14 provided in the January 22nd package as was stated by  
15 my friend. It was approximately a month later as part  
16 of a package of information which AECL provided which  
17 was marked as commercially confidential, and it was not  
18 used. So this table was not, as I understand it,  
19 reviewed extensively by Mr. Penn in preparation. But  
20 he is prepared to deal with it now and so that I think  
21 takes care of that.

22 On the other matter, with respect to  
23 Chapter 5, I think on reviewing the chapter, Mr. King  
24 and Dr. Whillans can deal with it to some extent, and  
25 what I have agreed with my friend is that we will try

1 and proceed on that basis. If we have to take  
2 undertakings to deal with various matters, we will do  
3 so.

4 I would point out that the focus of that  
5 chapter in the report is clearly on taking the results  
6 of literature, a literature review, certain results  
7 here and simply applying Ontario Hydro figures to those  
8 results, and that is what is reported in the chapter.

9 The notation on the table, for instance,  
10 OH (91) the reference to the report there is to the  
11 very report that you are holding in looking at that  
12 reference, as it turns out. It's this study, the OH  
13 (91) is this study. That wasn't made sufficiently  
14 clear and this study was not issued until '92. But the  
15 reference on that table is to the very study that is  
16 Exhibit 507.

17 As I say, I think we can proceed on that  
18 basis with Chapter 5 of 507. It speaks primarily to  
19 nuclear power related matters.

20 What I think we cannot do with this  
21 panel, nor do we propose to do, is to bring forward  
22 persons to be cross-examined on Exhibit 550, the 300  
23 year - I forget what the title is - that we cannot do.  
24 We can I think deal with much of Chapter 5 and I think  
25 we will just have to proceed on that basis. So if



1 something else then has to be done, then we will deal  
2 with it at that time.

3 MR. HEINTZMAN: Thank you, Mr. Chairman.

4 Q. Mr. Penn, you still have a copy of  
5 Exhibit 549 around?

6 MR. PENN: A. Yes, I do.

7 Q. And having had a chance to look at it  
8 over the lunch hour, can you help me on footnote No. 3  
9 to start off with, as to whether the footnote correctly  
10 stated the Hydro interest escalation factors?

11 A. Well, having checked over lunchtime  
12 with Ontario Hydro staff on this matter, I think the  
13 first thing I should comment on is that the Ontario  
14 Hydro economic parameters, footnote 2, and the first  
15 line of numbers for CANDU 3, CANDU 6 and CANDU 9, are  
16 based upon what is known as a forecasting method of  
17 calculating levelized unit energy cost, and that is in  
18 turn based upon Ontario Hydro's economics division  
19 long-term forecasts of discount rates, interest and  
20 escalation.

21 The second line known as AECL economic  
22 parameters, and LUECs of 4.8 for CANDU 3, 4.4 for CANDU  
23 6, and 3.3 for CANDU 9, are on the same base costs but  
24 use what is known as a constant real discount method of  
25 calculating levelized unit energy costs. In essence,

1 it means a 4 per cent real discount rate. And it is my  
2 understanding that AECL does that, or prefers that,  
3 because of comparisons with other vendors in the world  
4 who use 4 per cent real discount rate.

5 To get to the nub of your question, the  
6 equivalent discount rate, I am advised, for the Hydro  
7 forecasting method is 6 per cent real discount.

8 Q. And the other numbers referred to in  
9 footnote 3, 11 per cent interest rate -- I'm sorry,  
10 does the 6 per cent discount rate, is that reflective  
11 of the escalation of capital cost which I see a  
12 reference to 6 per cent escalation cost or is that  
13 something entirely different?

14 A. That is referenced to the whole  
15 period from the start of definition until the final  
16 service of the plant.

17 So that we use, in order to count  
18 levelized unit energy costs, we use a cash flow process  
19 for all these years, how the money is spent, and for  
20 all those years there are estimates of the interest  
21 discount and escalation rate.

22 All I am advising you is that on average  
23 it come out to a 6 per cent real discount or  
24 thereabouts.

25 MR. B. CAMPBELL: Mr. Chairman, there

1 were various people, as you can major having various  
2 telephone conversations about this, trying to sort it  
3 all out, this is one that I should advise me friend I  
4 have been told by the people that did the Hydro  
5 calculations that all of the numbers in footnote 3 are  
6 AECL calculated numbers. They may have done those  
7 calculations based on various Ontario Hydro indices,  
8 but there are AECL calculated averages, as we  
9 understand it, of various Ontario Hydro indices. I  
10 think and in doing those calculations, as I understand  
11 it, AECL has also tried to capture some of the kinds of  
12 differences that Mr. Penn has spoken to and can speak  
13 to. But they are not Ontario Hydro calculated numbers  
14 in footnote No. 3.

15 Sorry, Mr. Heintzman, I meant to say that  
16 when I was up on this before.

17 MR. HEINTZMAN: That is fine. That's  
18 good.

19 Q. So your information is, it's a 6 per  
20 cent discount rate that Ontario Hydro has used for its  
21 calculations. Am I getting that right? 6 per cent  
22 discount.

23 THE CHAIRMAN: He said 6 per cent real  
24 interest rate.

25 MR. HEINTZMAN: No, he said 6 per cent

1 discount rate.

2 MR. PENN: I'm sorry, I meant real  
3 interest rate.

4 MR. HEINTZMAN: Q. There is a quite a  
5 difference between a real interest rate and discount  
6 rate. You are sure it's an interest rate or is it a  
7 discount rate?

8 MR. PENN: A. Well, what I am sure about  
9 is that the Ontario Hydro economic parameters in the  
10 first line are based upon a forecast method of  
11 calculating using the indices that Ontario Hydro has  
12 published recently for interest, discount rate, and  
13 escalation. And as I understand it, the parameters  
14 used by AECL in the second line use a real discount  
15 rate of 4 per cent, and that is the basic reason  
16 between those two sets of numbers.

17 Q. Well, I don't think there is such a  
18 thing as real discount rate. You either have a  
19 discount rate of a number or you have a real interest  
20 rate.

21 I understand the first time you told us  
22 you were referring to a 4 per cent discount rate that  
23 you thought AECL was using, and a 6 per cent discount  
24 rate that you were informed Ontario Hydro was using.

25 A. Well, to be quite clear, the first

1 set of numbers, if you were to put that in terms of an  
2 average real discount rate, it would be about 6 per  
3 cent over the period.

4 The second line of numbers, which AECL  
5 has used, relate to a 4 per cent real discount rate  
6 over the period.

7 Q. Well, my understanding would be that  
8 the word "real" wouldn't apply to a discount rate, but  
9 I will leave it at that.

10 A. That's what financial people at  
11 Ontario Hydro have advised me.

12 Q. Yes. Okay.

13 I understood the first part of your  
14 answer to indicate that the 4 per cent, whatever it is,  
15 was understood by you to be reflective of what AECL  
16 thought was what other vendors in the market were  
17 using.

18 A. It's my understanding that in the  
19 international markets, typically U.S. vendors and  
20 Japanese, and maybe in the Far East, use normally 4 per  
21 cent real discount rates, and that AECL, in doing its  
22 business in competition, would want to use that.  
23 That's the point I was trying to make to you.

24 Q. So that line 2 would be reflective,  
25 insofar as it uses a 4 per cent rate, of costs



1 associated by other vendors using the same, as you have  
2 told us, percentage rate?

3 A. Again, the second line of numbers is  
4 based upon calculating levelized unit energy costs by a  
5 real discount, constant real discount method which in  
6 turn, as your footnote 3 states, is 4 per cent -- it  
7 says real interest rate here, my advice from Ontario  
8 Hydro over lunch is what it should say is 4 per cent  
9 real discount rate.

10 Q. Whatever it is, do I understand that  
11 according to Ontario Hydro's information, that's the  
12 rate that people in the industry are using?

13 A. For comparative purposes.

14 Q. Yes. So that by using 6 per cent  
15 rate, Ontario Hydro is using what I think you have  
16 described as a more conservative approach; would that  
17 be fair?

18 A. Well, our economics division I  
19 believe would say it's a more realistic approach.

20 Q. It's certainly more conservative than  
21 4 per cent.

22 A. It's certainly bigger.

23 Q. Yes. All right.

24 Anything else about Exhibit 549 that you  
25 were able to --

1 A. Yes. If we now turn to the lower  
2 line.

3 Q. Yes?

4 A. Which has the superscript 4 and  
5 information provided to us from AECL subsequent to the  
6 original information, that the first two lines are  
7 based on. I would like to point to you that there are  
8 a number of differences and assumptions.

9 One is that the first two lines related  
10 to earliest in-service. So typically, CANDU 3, 6 and 9  
11 at that time would be considered for in-service in the  
12 period of 2003/2004. The third line relates to  
13 in-service of plant in 2010. So that's No. 1  
14 different.

15 And No. 2 difference is that some of the  
16 capital costs have been updated on advice from AECL.  
17 One includes the assumption of what is known as a  
18 generic site, as opposed to the first two lines which  
19 were an existing site and in Hydro's mind was  
20 Darlington.

21 The difference between the two is that  
22 the long intake tunnel and discharge tunnel from the  
23 condenser would be a lot more expensive for the  
24 existing Darlington site than a generic site. So there  
25 a difference in costs there.

1                   As it notes, in superscript 4 at the  
2                   bottom page, the bottom line does not include owner's  
3                   costs. Owner's costs include things such as  
4                   environmental assessment, regulatory requirements, AECEB  
5                   licensing fees, site improvements, switch yards,  
6                   corporate overheads and project management by Ontario  
7                   Hydro.

8                   [2:48 p.m.]

9                   Again, another difference is that the  
10                  lower line assumes commissioning and training costs  
11                  suggested by AECL. They are different from Ontario  
12                  Hydro's assumptions.

13                  Finally, the contingencies in the upper  
14                  two lines are different from the contingency in the  
15                  third line. The CANDU 6 is unchanged at 15 per cent;  
16                  the CANDU 3 and CANDU 9 in the upper lines adopted  
17                  Hydro's position of 25 per cent contingency on an  
18                  evolutionary plant.

19                  Given that the in-service date was now  
20                  2010, AECL regarded it as nth-of-a-kind plant;  
21                  therefore, there was considerable experience and the  
22                  contingency would be lower at 15 per cent.

23                  Q. Lower at 15 per cent?

24                  A. Lowered to 15 per cent. Now, that's  
25                  a matter of judgment. Ontario Hydro's position was

1 that it preferred to take a conservative view at this  
2 time.

3 Q. Is that it?

4 A. That's it.

5 Q. Thank you very much. I wonder if we  
6 can come back now to Mr. King and Dr. Whillans, and on  
7 reviewing the transcript, Dr. Whillans, it appears that  
8 most of the comments about Exhibit 507 came from you  
9 and so I will direct these questions to both you and to  
10 Mr. King.

11 I am wondering if you could look with  
12 me -- Mr. Hamer had attended, and I believe will come  
13 back to Exhibit 507 in more detail than I had intended  
14 to do, but since we were brought to it in our  
15 discussion this morning I would just like to assist our  
16 discussion by reference to it.

17 If you look at the end of that document  
18 to the references, pages 6-1 to 6-7, there are seven or  
19 six-and-a-quarter pages of references that are relied  
20 upon in this document to arrive at tables 5-1 to 5-4,  
21 which is your calculation of fatalities per gigawatt  
22 per annum.

23 DR. WHILLANS: A. I believe these  
24 references refer to the whole document, not just to  
25 chapter 5.

1 Q. I see. All right. If you look  
2 across these tables, you will find references to these  
3 various studies.

4 A. Yes.

5 Q. And if you look with me at Exhibit  
6 550, page 187--

7 A. Yes?

8 Q. --many of the sources relied upon for  
9 these authors' calculation of the serious effects,  
10 fatalities per gigawatt per annum, which seems to be  
11 the same calculation, are relying upon the same  
12 sources.

13 I have started to check some off during  
14 lunch hour and -- UNSCEAR, Inhaber, Hamilton, ACNS,  
15 Fritzsche, these appear to be standard sources, whether  
16 it be for Ontario Hydro or the Institute for Risk  
17 Research.

18 A. They are the same sources, yes.

19 Q. All right. So that what we have in  
20 Exhibit 550 is the kind of information upon which  
21 Ontario Hydro relies and relied?

22 A. Certainly some of the sources are the  
23 same, yes.

24 Q. All right. And so if we look then at  
25 table 6.1B in their analysis what the authors have done



1 is take, for instance, from nuclear on page 187 the  
2 various effects you can see under "Public", the figure  
3 of 0.18 for something known as UNSCEAR, and various  
4 other effects, and arrived at a total serious effects  
5 on page 188 of .8. Do you see that?

6 A. I am looking for the reference you  
7 made to UNSCEAR.

8 Q. Page 187.

9 A. Yes.

10 Q. Under the column "Public".

11 A. Yes?

12 Q. It's the first one.

13 A. Oh, yes?

14 Q. .18.

15 A. Yes.

16 Q. Serious effects, i.e. fatalities per  
17 gigawatt per annum--

18 A. Right.

19 Q. --which I understand to be arrived at  
20 by this study conducted in 1988 by an organization  
21 known as UNSCEAR.

22 A. Right.

23 Q. And utilizing that information these  
24 authors have arrived on the next page at a total  
25 serious effects for nuclear of .8.

1 A. Right.

2 Q. And that is the kind of analysis that  
3 you were going through in these tables 5-1 and  
4 following in Exhibit 507; is it not?

5 A. Of course, I don't know exactly how  
6 the analysis in Table 6-1B was carried out without  
7 reading the document, but it is probably this kind of  
8 analysis.

9 In our report we refer to a number of  
10 analyses and show that there are differences depending  
11 on how the analysis is done and if this is fatalities  
12 per gigawatt year the number is somewhat different from  
13 the one in chapter 5 in our report. But they are  
14 comparable, yes.

15 Q. Well, the authors tell us on page 188  
16 in the footnote:

17 The values adopted in this study are  
18 based on judgments and review of the  
19 extensive studies (selected sample cited  
20 in table 6-1A)..., et cetera?

21 A. Right.

22 Q. And then, on page 189 in figure 6.1  
23 the authors show these studies in a tabular form so  
24 that running down the page to the bottom you can see  
25 total serious effects (fatalities per gigawatt per

1 annum), and you can go up and look at the World Health  
2 Organization in 1977, how many fatalities per gigawatt  
3 per annum they thought was appropriate to nuclear, and  
4 UNSCEAR, and the various studies referred to on page  
5 187 are put here now for us in tabular form.

6 A. Yes.

7 Q. We can then look down at coal and see  
8 that there are very much larger bar graphs running out  
9 to reference the studies, many of which are comparable,  
10 i.e. studied nuclear as well as coal, for the  
11 fatalities per gigawatt per annum.

12 Do you see that?

13 A. That is what the figure shows, yes.

14 Q. And for hydro and for oil and for  
15 gas. So this is the kind of analysis that these  
16 gentlemen went through, and that is comparable to what  
17 Hydro went through in Exhibit 507?

18 A. Yes, and, in fact, in 507 there is  
19 some explanation for why there are differences amongst  
20 the different numbers that are shown for nuclear.

21 Q. And perhaps if you want to refer me  
22 to that in Exhibit 507?

23 A. On page 523 of 507 there is a similar  
24 sort of chart which includes the UNSCEAR 1988, the  
25 Hamilton 1984, the ACNS 1990, Fritzsche 1989, and this

1 present report, and on page 522 opposite, the last two  
2 paragraphs refer to this figure 5.4 and explains some  
3 of the differences in the assumptions that were made by  
4 the various organizations and why they resulted in  
5 different numbers.

6 DR. CONNELL: Dr. Whillans, I take it in  
7 this study there is no assessment of the risk of being  
8 bored to death in environmental hearings or being  
9 crushed under toppling heaps of exhibits? [Laughter]

10 DR. WHILLANS: I think not.

11 MR. HEINTZMAN: Q. And if you would turn  
12 to page 5.24 of this exhibit, 507, in the last full  
13 paragraph the following is stated:

14 As stated above, the overall risk  
15 reported in this report is .22 fatalities  
16 per gigawatt per annum. (ACNS-10, 1989)  
17 reports risks values of 6.1 to 8.6  
18 fatalities per gigawatt per annum for the  
19 coal cycle and .33 to 1.1 fatalities per  
20 gigawatts per annum for hydraulics cycle  
21 (ACNS-10, includes materials  
22 acquisitioned for hydraulic construction  
23 which was excluded in this report).  
24 Very similar results are reported by  
25 Fritzsche (1989) for these fuel cycles.

1 DR. WHILLANS: A. That is what it says,  
2 yes.

3 Q. So that Hydro is reporting that the  
4 risk values for these three cycles are .22 for  
5 nuclear -- sorry, 6.1 to 8.6 for coal, and .33 to 1.1  
6 for hydraulic.

7 A. Well, I think Hydro is reporting that  
8 these references give values of, for instance, 6.1 to  
9 8.6 for coal. That is not a result of a Hydro  
10 analysis.

11 Q. No, but this document, 507, is a  
12 literature analysis or search; right?

13 A. Yes.

14 Q. And so is Mr. Nathwani and Mr.  
15 Siddall and Professor Lind. They did a literature  
16 analysis to come up with a similar type of approach?

17 A. Well, as I said, I haven't read the  
18 300 year report, but from the pages you have referred  
19 to I think there is quite a lot more analysis in what  
20 they have done than just similarly a literature search?

21 Q. Yes, they applied professional  
22 judgment and whatnot and analysis using literature  
23 searches, but the conclusion that we looked at, now  
24 that Mr. King drew us to in the opening portion of the  
25 document, summary, the fourth conclusion --



1 A. Sorry, which document?

2 Q. Exhibit 550.

3 A. 550.

4 Q. Sorry, the fifth conclusion.

5 A. What page is that?

6 Q. Well, it doesn't have a page number.

7 It is immediately prior to the contents, and it is the  
8 third physical page.

9 A. Yes?

10 Q. The third conclusion is:

11 Nuclear supply option confers the  
12 greatest expected net benefit.

13 A. Sorry, I thought I had it, but I am  
14 lost here. Oh. That is the fifth conclusion; right?

15 Q. Yes, fifth conclusion.

16 A. Yes. That is what the report  
17 concludes, yes.

18 Q. Yes. And that is consistent with  
19 what is shown in graph and other form in tables 6.1A,  
20 6.1B and 6.1 from the studies there referenced?

21 A. Well, can you tell me what page that  
22 that is, again? Sorry. Here we are.

23 Q. 187, 188, 189.

24 A. Their conclusion is consistent with  
25 the information in their report, yes.

1 Q. Yes. And it is consistent with the  
2 paragraph on page 5-24 from Exhibit 507 that we read  
3 into the record?

4 A. It is consistent with the literature  
5 which is reported in that paragraph, yes.

6 Q. And so my question to you is: That  
7 is the conclusion to which the literature, the reliable  
8 literature has arrived at, is it not, that on a  
9 comparative basis nuclear generation is from a risk  
10 standpoint likely to provide the greatest expected net  
11 benefit?

12 A. I'm sorry, I am not qualified even to  
13 tell you whether this is even the reliable literature.  
14 Other than the nuclear, I don't have any expert  
15 opinion.

16 Q. Well...

17 MR. KING: A. If I could add something,  
18 Mr. Heintzman --

19 THE CHAIRMAN: I want to make sure I  
20 understand that answer.

21 Is it reliable as far as nuclear is  
22 concerned, I take it; is that right?

23 DR. WHILLANS: Well, perhaps I should  
24 qualify that. Included in these risks are risks from  
25 other parts of the fuel cycle and--

1 THE CHAIRMAN: I see.

2 DR. WHILLANS: --while I believe I am  
3 familiar with the--

4 THE CHAIRMAN: The generation part of the  
5 fuel cycle?

6 DR. WHILLANS: --health effects involved  
7 I am not -- that is right, yes.

8 MR. HEINTZMAN: I wonder if you could  
9 turn on your microphone, Dr. Whillans, so that --

10 DR. WHILLANS: It is on.

11 MR. HEINTZMAN: Q. Oh, I'm sorry. I  
12 couldn't hear you.

13 The reports referred to on page 5-24 of  
14 Exhibit 507 address more than, do they not, the  
15 generation aspect of nuclear generation? Am I not  
16 correct in that? Or can you help me?

17 DR. WHILLANS: A. Yes. I think I should  
18 say that, in my view anyway, the purpose of this  
19 chapter was to provide a context for the nuclear risk  
20 associated with our generation.

21 So in, for example, table 5.1 on 528  
22 there is a summary presented of fatalities per gigawatt  
23 year from all forms of risk for all parts of the fuel  
24 cycle.

25 Most of this data is drawn from

1 literature references. I think the purpose here was to  
2 show the relative importance of the generation risk for  
3 occupational or public and just show that we are  
4 dealing with the dominant aspect.

5 Q. No, but 5-1 deals with everything  
6 from mining to all aspects of the nuclear generation--

7 A. Yes.

8 Q. --cycle.

9 A. Yes.

10 Q. And you have relied upon the studies  
11 that are shown in your report or this report, Exhibit  
12 507, starting at page 6-1.

13 A. Yes.

14 Q. And you are not suggesting to the  
15 Chairman that these studies are reliable for the  
16 generation aspect but not reliable for the other  
17 aspects, are you?

18 A. I am not suggesting, but it is  
19 certainly possible.

20 Q. But you have relied upon them for all  
21 aspects of them, from mining right through to the other  
22 aspects.

23 A. Well, I thought your previous  
24 question had to do with studies which made estimates  
25 for nuclear and for coal and for gas, and I was

1 suggesting that it could be reliable for nuclear and  
2 not for the others. That is all I can comment on.

3 Q. Are you suggesting that is a likely  
4 result?

5 A. I have no opinion.

6 Q. Well, have you studied these kinds of  
7 reports?

8 A. No.

9 Q. Well, you have relied upon them for  
10 risk analysis for not just the generation aspect of  
11 nuclear but other aspects of nuclear?

12 A. Yes.

13 Q. So you are satisfied that they are  
14 reliable not just in the generation aspect but in the  
15 other aspects?

16 A. Yes, but I think I said that my  
17 degree of satisfaction is highest in the generation  
18 area where we have experience and I am less confident,  
19 of course, about things like mining operations.

20 Q. Why is that? Or let me put it this  
21 way: Is that stated anywhere in this report, that  
22 there is a less confidence factor for the mining or  
23 milling or transportation or whatever aspects?

24 A. I think you asked me about my  
25 confidence. I am more familiar with the information in



1 the generation area, less familiar with other aspects  
2 of the fuel cycle, and not at all familiar with other  
3 kinds of fuel cycles.

4 Q. But there doesn't seem to be any  
5 logical reasoning that I can think of why any of these  
6 studies which you have relied upon would be less or  
7 more reliable for nuclear generation than they would be  
8 for the other comparable forms of generation.

9 A. Well, to the extent that they rely on  
10 similar methods I think that is reasonable, but I don't  
11 know whether the basic data for other fuel cycles is as  
12 good as it is for nuclear, for example.

13 [3:10 p.m.]

14 Q. Well, do you have any basis to  
15 suggest to the Board that the sources used by you or in  
16 Exhibit 550 are less reliable for other kinds of  
17 generation than nuclear?

18 A. No.

19 Q. And generally speaking, those sources  
20 have been considered to be reliable by Ontario Hydro in  
21 preparing their information?

22 A. For nuclear, yes.

23 Q. Well, if we find that they are  
24 referred to in the fossil panel as well, then that  
25 would give us further comfort.

1 A. Yes, it should.

2 Q. Yes. Would you agree, Dr. Whillans,  
3 that a risk analysis of this nature is an essential  
4 thing to be done in order to analyze any energy option  
5 from an environmental standpoint?

6 A. I am hesitating because I am  
7 certainly not an expert in risk analysis.

8 If you mean of this nature a summary such  
9 as we have done, or the analysis which I think is in  
10 the larger report, I agree that that sort of analysis  
11 should be done, yes.

12 Q. Yes. And to the extent that one  
13 energy option hasn't had any risk analysis of this  
14 nature done on it, then one should be concerned about  
15 whether that is something one should rely upon?

16 A. You are asking me personal view?

17 Q. Yes.

18 A. Yes, I would be concerned.

19 Q. And to the extent that, for instance,  
20 demand management has not been analyzed as to the risks  
21 that that imposes upon society, then one has to be  
22 concerned about that?

23 A. If that is the case, yes, I would be  
24 concerned.

25 Q. And these authors, for instance, in

1 Exhibit 550 expressed an opinion that - I just want to  
2 make sure I get the right expression as to how they put  
3 it - the words they use are conservation, by which they  
4 mean, if I am referring to page 143, not to meet the  
5 predicted energy demand but to follow policies designed  
6 to induce or to force the reduction of consumption  
7 below what is shown in anything 4.3.

8 MR. B. CAMPBELL: What is figure 4.3?

9 MR. HEINTZMAN: That is a figure with  
10 respect to use of energy which you will find on page  
11 138.

12 Q. The authors in this report express  
13 the opinion that that approach has a more deleterious  
14 impact upon risk, a higher risk than any of the energy  
15 alternatives that they examined. Are you aware of  
16 that?

17 DR. WHILLANS: A. Sorry, where do they  
18 express that opinion?

19 Q. Well, in various places.

20 Page 257, paragraph 6 where they say:

21 None of the options for supplying the  
22 needed extra energy presents any  
23 important risk to life or health. The  
24 extreme conservation option, that is, not  
25 meeting the demand, would result in the

1 biggest risk by slowing down the rate of  
2 increase of life expectancy that would  
3 otherwise have occurred.

4 Do you see that?

5 A. I see that, yes.

6 Q. Would you agree with me that  
7 analyzing an option of that nature from a risk  
8 standpoint is important?

9 A. Yes.

10 Q. Well, I think I will leave Exhibit  
11 550 there and 507, and Mr. Hamer may have further  
12 discussions with you on that document, or 507.

13 A. Sorry, before I leave, did you show  
14 me where they said that that hadn't been done?

15 Q. I'm sorry?

16 A. That there hadn't been such an  
17 analysis for conservation?

18 Q. No, they did one in this report in,  
19 Exhibit 550, and arrived at that conclusion.

20 A. I see.

21 MR. B. CAMPBELL: Just a minute.

22 Mr. Chairman, in fairness I think my  
23 friend has been a little loose with his terminology to  
24 say that what is there as a blanket statement is an  
25 analysis of conservation, the effects of conservation,

1 is, in my submission, simply not correct.

2 The document is quite clear that there  
3 are some very specific definitions attached to what  
4 they mean as an extreme conservation measure, and I  
5 just point out that that definition has little, if  
6 anything, to do with the kinds of conservation that are  
7 being proposed by Ontario Hydro in this proceeding, and  
8 I think in fairness, that should be recorded.

9 MR. HEINTZMAN: I am glad my friend is  
10 giving evidence. I think it is up to the Board to draw  
11 the conclusion as to what connection the two have.

12 MR. B. CAMPBELL: I'm sorry, there has  
13 been evidence given on this matter already. It is  
14 quite clear that nothing approaching the extreme  
15 conservation scenario is what is being contemplated in  
16 Ontario Hydro's programs. In fact, the evidence was  
17 directly to the contrary.

18 MR. HEINTZMAN: I don't believe we have  
19 had any evidence with respect to the conservation or  
20 demand management in the Update to date.

21 MR. B. CAMPBELL: This hearing consists,  
22 Mr. Chairman, in my submission of much more than the  
23 Update.

24 I am trying to make sure that the  
25 terminology isn't getting mixed up. This matter has



1       been dealt with it and to say that conservation has the  
2       effects in 550 ignores the fact that conservation as  
3       it's been used in this hearing may have several  
4       different definitions, and the one in 550 is a long way  
5       from what Ontario Hydro is talking about.

6                   MR. HEINTZMAN: Q. Let's go on to the  
7       next subject. I am coming back to you, Mr. Penn. What  
8       I would like to discuss with you for the next few  
9       minutes is an extension of the discussion you and I had  
10      about the time that is necessary to plan and build a  
11      nuclear generating facility. You and I reviewed the  
12      fact that the time to do so has become longer and  
13      longer as we have seen from the time it has taken  
14      Ontario Hydro and others to built those kind of  
15      facilities. Is that a fair summary to start our  
16      discussion?

17                   MR. PENN: A. We did discuss that  
18      matter, yes.

19                   Q. I would like to take you to Exhibit  
20      519, page 74, as a starting point of the present  
21      discussion.

22                   A. Yes, I have that.

23                   Q. And at the bottom of that page, which  
24      we looked at before, and it comes from the nuclear  
25      options study, you, in setting out the definition phase

1 and the acquisition phase, say at the bottom: Assumes  
2 mid-1993 start date for definition phase.

3 A. Yes.

4 Q. So that assumes that by 1993 the  
5 nuclear moratorium has come to an end, that you have  
6 gone through the stage of selecting one or more of the  
7 options set out on page 81, and are now into the  
8 definition phase; is that a fair statement?

9 THE CHAIRMAN: I am sorry, page 81?

10 MR. HEINTZMAN: Page 81 sets out all the  
11 options that are going to be analyzed for purposes of  
12 proceeding with a project.

13 MR. B. CAMPBELL: I'm sorry, I thought  
14 Mr. Penn's testimony was quite clear that the selection  
15 of the option might well extend through the concept and  
16 definition phase of the project. I thought he was  
17 quite clear on that.

18 MR. HEINTZMAN: I don't believe he was,  
19 and I am sure Mr. Penn can correct me if I am wrong.

20 Q. Did I understand you to say that up  
21 to and including the concept phase you would  
22 narrow the choice down to those you want to proceed  
23 with in definition?

24 MR. PENN: A. I said that we would  
25 likely select several, I was meaning three or four,

1 that we could carry into the definition phase,  
2 depending on the circumstances.

3 Q. Right, okay.

4 A. I am not sure I understood your  
5 original question to me, but I would like to make note  
6 of the fact that I made the assumption, since you have  
7 to start at some date in order to arrive at an  
8 in-service date, I made the assumption that the  
9 earliest time that the nuclear moratorium might be  
10 lifted would be June of 1993, and that's where all  
11 these schedules start from, or at least they did in  
12 this part of the study.

13 Q. Yes. And the lifting of the nuclear  
14 moratorium would be as a consequence of a decision of  
15 this Board recommending that the nuclear option  
16 proceed. That's what you have assumed.

17 A. No, I didn't assume that. I assumed  
18 that the earliest conceivable time that anyone might  
19 make the decision would be following the findings of  
20 this Board. I didn't assume that it would necessarily  
21 be this Board.

22 Q. All right. So you have assumed that  
23 there will be a finding of this Board and thereafter a  
24 lifting of the nuclear moratorium and thereafter the  
25 start date referred to on this page is assumed to

1 occur?

2 A. As the earliest possible, yes, start  
3 date.

4 Q. And those two events have to occur  
5 before you can start defining these options; don't  
6 they?

7 A. Absolutely.

8 Q. Yes. And you have said that on page  
9 78, at the top left-hand corner of the one lead time  
10 analysis that you did provide for us, top left-hand  
11 corner of Exhibit 519, page 78, the first thing you say  
12 in the top left-hand corner is: DSP hearings finished,  
13 nuclear moratorium lifted. So you have assumed that in  
14 order to start your lead time analysis?

15 A. Well, the format that this particular  
16 lead time of a CANDU 6, which is for in-service of  
17 2010, was general.

18 I don't want you to understand that I am  
19 suggesting that looking at that figure, which is on  
20 page 78, that the DSP hearings would take until October  
21 1999. I was hoping that they might be earlier.

22 [Laughter]

23 Q. I assumed that it was the same date  
24 as in page 74, i.e., mid-1993?

25 A. That's quite correct, sir.

1 Q. Thank you.

2 Now, what you have given on page 78 is a  
3 lead time analysis for the CANDU 6 which you could have  
4 prepared, and I suggest you must have or notionally did  
5 for each of the other alternatives.

6 A. We did for quite a number of them.  
7 We didn't for every one of them.

8 THE CHAIRMAN: I am just a little  
9 confused now, excuse me. The October 1, 1999 figure  
10 shown on page 78, is the time you put in for DSP  
11 hearings finished; is that right?

12 MR. PENN: No, it isn't, sir. That's  
13 what I was trying to point out.

14 What that is - and it is incorrectly  
15 stated, and I'm sorry about that - that is the start of  
16 the definition phase in order to have that particular  
17 option in-service on January 9, 2010. That's when we  
18 would have to start assuming that a hearing into the  
19 matter, once the EA document is submitted in spring of  
20 2001, would take 24 months.

21 THE CHAIRMAN: It's not this hearing  
22 that's going to--

23 MR. PENN: Not this hearing.

24 THE CHAIRMAN: --deal with that, is that  
25 not right, in your view?



1 MR. HEINTZMAN: What the witness has told  
2 us is what he has set up in the top left-hand corner of  
3 page 78 is the date that is on page 74, if you go back  
4 to page 74.

5 MR. B. CAMPBELL: No, that's not what he  
6 said. No.

7 THE CHAIRMAN: That's a 1993 date.

8 MR. HEINTZMAN: Exactly.

9 THE CHAIRMAN: That's not even on this  
10 chart, 1993.

11 MR. HEINTZMAN: That's right. That's  
12 what he told us, in the making the statement at the top  
13 left-hand corner on page 78, he has assumed that --  
14 what he advised me with respect to page 74, namely, the  
15 DSP hearings would have completed and a decision to  
16 cancel the nuclear moratorium had been given in  
17 mid-1993.

18 THE CHAIRMAN: But he is not talking  
19 about this hearing.

20 MR. HEINTZMAN: Yes, he is talking about  
21 this hearing.

22 MR. B. CAMPBELL: I think there is total  
23 confusion here.

24 My understanding of what Mr. Penn has  
25 said is that the notation --

1 MR. HEINTZMAN: I don't want my friend to  
2 state his conclusion. We can go back and have the  
3 transcript read back, if necessary.

4 MR. B. CAMPBELL: I think he has made a  
5 correction to page 78 and I would like him --

6 MR. HEINTZMAN: I don't want my friend to  
7 interrupt my cross-examination.

8 I have a perfectly clear answer on the  
9 record and if you wish it to be read back, then I would  
10 like to have it read back.

11 MR. B. CAMPBELL: You have a perfectly  
12 clear correction on the record as well.

13 THE CHAIRMAN: I don't think there is  
14 much to be gained by this. It's really between you and  
15 Mr. Penn. I just want to make sure we are all talking  
16 about the same thing, that's all. Perhaps I shouldn't  
17 even have intervened.

18 When you were talking about the DSP  
19 hearing, I asked the question what DSP hearing are you  
20 talking about. I want to make sure that the two of you  
21 understand which one you are talking about.

22 MR. HEINTZMAN: I would prefer to have  
23 the evidence read back as to what the witness said, and  
24 he said exactly that.

25 MR. PENN: Mr. Chairman, it may be my

1 fault in not being clear in discussing this with you.

2 What I did say, and I believe the record  
3 will bear me out, that this particular chart is a  
4 standard chart that we have used for many different  
5 options in putting lead times down. The notation on  
6 the upper left-hand corner that says DSP hearings  
7 finished, nuclear moratorium lifted, is not supposed to  
8 refer to October 1999. It's intended refer to the  
9 start of the definition phase to get this particular  
10 option in-service by 2010.

11 Unfortunately, that notation, which I  
12 hadn't realized before, has clearly mislead us. I did  
13 make a joke earlier to say that I very much hope that  
14 this hearing would be finished before 1999.

15 MR. HEINTZMAN: Yes.

16 THE CHAIRMAN: How do you read the event  
17 DSP finished, nuclear moratorium lifted, where do you  
18 think that happens on this chart?

19 MR. PENN: It's irrelevant actually. But  
20 I have previously assumed for earliest in-service that  
21 it would happen in June 1993.

22 THE CHAIRMAN: Which is not on the chart.

23 MR. PENN: Correct, sir.

24 THE CHAIRMAN: And those two little dots  
25 that I see in '94 have no significance?

1 MR. PENN: That must have been on the  
2 Xerox machine.

3 MR. HEINTZMAN: Or Mr. Campbell didn't  
4 quite erase what was there.

5 Q. But the same date is the date on page  
6 74 which is the date that we previously went over,  
7 assumes mid-1993 start date, that --

8 MR. PENN: A. That has nothing  
9 whatsoever to do with this particular option being  
10 in-service in 2010. We don't need the moratorium  
11 lifted for this particular option for 2010.

12 Q. Absolutely. We are going to go  
13 through that. But your assumption for all of these  
14 analyses - and we are going to go through it in some  
15 detail - is that the DSP, this hearing, has been  
16 concluded and the nuclear moratorium is lifted by  
17 mid-1993.

18 A. But it would only be relevant for the  
19 earliest possible in-service for any of the nuclear  
20 options.

21 Q. Yes, and we are going to go through  
22 those. But that's your constant assumption in  
23 approaching these options?

24 A. That assumption is not necessary for  
25 in-service of 2010. And as you can see, that we would

1 start the first activities beyond the 5-year action  
2 plan period.

3 Q. I appreciate that. But when we go  
4 through these various options, some of them are very  
5 much longer than the lead times shown on page 78.

6 A. Yes, they are.

7 Q. Yes. And what you have done is you  
8 have made a constant assumption, in the lead time for  
9 CANDU 6 you don't need that lead time because it's only  
10 ten-and-a-quarter years, but the constant assumption  
11 you have made throughout this is (A) a decision by this  
12 DSP hearing, and (B), a lifting of the moratorium by  
13 mid-1993?

14 A. No, I have not made an assumption  
15 with regard to these options being in-service in 2010  
16 with regard to the DSP moratorium, the new nuclear  
17 moratorium being lifted. It is unnecessary to make  
18 that assumption.

19 The only reason to make the assumption is  
20 if you want to find out what the earliest in-service  
21 date of a nuclear project might be. That's the only  
22 reason, because you have to have a start date.

23 THE CHAIRMAN: Couldn't we have this  
24 discussion without talking about the -- what you really  
25 want to get at, I may be being very presumptuous - is



1       how long it takes to put one of these various  
2       technologies into service, from the time you are able  
3       to start doing that in the definition phase. I take it  
4       that's what you want to know.

5                   MR. HEINTZMAN: Yes.

6                   Q. Let's turn to page 81.

7                   For each of these options you have  
8       assumed a lead time by either shorter or longer for  
9       each of the options?

10      [3:30 p.m.]

11                  MR. PENN: A. Yes, I have, yes.

12                  Q. And I have - because I have  
13       difficulty dealing with months - gone down the  
14       right-hand side and these are the years that is  
15       opposite each line. Fifteen years is 180 months?

16                  A. Yes. In the right-hand column these  
17       are the lead times in months for building the various  
18       options on either an existing site, which would be the  
19       lower number, or a new site, which would be the higher  
20       number.

21                  Q. Yes. But let's get the higher  
22       numbers on the record.

23                  A. Yes.

24                  Q. And I am just going to read them out,  
25       and somebody can correct my math later, but using the

1 higher number, the numbers are: 15 years; 13-1/2  
2 years; 14 years; 11-1/6th years; 13 years, one month;  
3 14-1/2 years; 14 years; 14-3/4 years; 14 years; 13  
4 years; 13-1/2 years?

5 A. Yes, I take that as being correct.

6 Q. All right. So that the object of the  
7 exercise here is to enable Ontario Hydro to meet any of  
8 these options and to select the one that is the best  
9 for it?

10 A. The one that is needed by the Hydro  
11 for the province, yes.

12 Q. And it may be No. 1?

13 A. It could be.

14 Q. And it could be -- which is 15 years,  
15 and it could be System 80 Plus, which is 14-1/2 years?

16 A. It could be.

17 Q. And it could be BWR-90, 14-3/4 years;  
18 right?

19 A. Right.

20 Q. Right. And any sensible planning  
21 process will allow Hydro to put into plan any of those  
22 options?

23 A. Yes.

24 Q. Right. So that if we look to the  
25 Update and we see that new generation, new major supply

1 is needed in 2009, and if we want to give Hydro the  
2 ability to put any of these options into play, then we  
3 need to tell Hydro that it can start the definition  
4 phase in 2009, less 15, which is 1994?

5 A. Yes.

6 Q. Right. So Hydro needs a decision  
7 before 1994 which will enable it to make these choices  
8 or to make this choice?

9 A. I think that is an interpretation,  
10 yes.

11 Q. Well, that is the fact, isn't it?

12 A. Well, I would like to comment, first  
13 of all, that the lead times for new sites are quite  
14 conservative. We don't know really where this new site  
15 is.

16 Q. Well, you have allowed in your plan a  
17 two-year site-specific hearing in your CANDU 6  
18 analysis. After we have the DSP hearing finished, as  
19 you have said up in the top lefthand corner, you have  
20 allowed for a 24-month site-specific hearing, haven't  
21 you?

22 A. Well, there is a lot more to it than  
23 just the hearing process. We have allowed 2-1/2 years  
24 to prepare the environmental assessment for new sites.  
25 We had assumed that it wouldn't matter to an

1 environmental assessment hearing whether it was a new  
2 site or an existing site and that the time period for  
3 the hearing could be the same.

4 We have assumed, on the other hand, that  
5 a new site would take three years to prepare as opposed  
6 to as little as 16 months on some of the existing  
7 sites, and we have assumed that it would take at least  
8 a year more to construct on a new site than on an  
9 existing site, and all I am trying to point out to you  
10 is with all those assumptions, which we believe has  
11 been very conservative, that it is certainly not beyond  
12 the wit of man to reduce some of it.

13 Q. I have no doubt, but you have allowed  
14 24 months on page 78 for what I have been calling and I  
15 think you have just said is a site-specific hearing;  
16 right?

17 A. A project site-specific hearing, yes.

18 Q. And you can't guarantee to us that  
19 any Environmental Assessment Board or Hydro will wish  
20 an existing site to be the site for the next generating  
21 station, can you?

22 A. Certainly not.

23 Q. Right. And it would be foolhardy in  
24 the extreme to embark upon an approval process where  
25 you have limited yourself to an existing site and then

1 end up in front of an Environmental Appeal Board that  
2 says, I'm sorry, but that's not the right site?

3 A. We have made absolutely no decisions  
4 on existing or new site.

5 Q. Right. So that from at a planning  
6 perspective, from your perspective, you have to go with  
7 the longer dates on page 81 because you have got no  
8 guarantee from an Environmental Assessment Board or  
9 from Hydro that an existing site is the site on which  
10 this generating station is to be located; right?

11 A. I agree entirely. All I was meaning  
12 to say to you is, and thinking about the 15 years, for  
13 example, that that is a maximum period of time, and  
14 there is clearly opportunity to reduce it.

15 Q. Obviously, but --

16 A. That's all I was trying to explain to  
17 you.

18 Q. But from any sensible perspective in  
19 order that you are not tied down to an existing site,  
20 in order that Hydro can make the appropriate selections  
21 Hydro has to have a decision by 1994 as to whether it  
22 can proceed with nuclear generation, doesn't it?

23 MR. B. CAMPBELL: Well, Mr. Chairman, I  
24 am not sure that that is at all a fair question to put  
25 to Mr. Penn. I think that we have a Panel that is



1 coming up to --

2 THE CHAIRMAN: No, no. Mr. Campbell.  
3 Mr. Campbell. That's not right. We are talking about  
4 what kind of time you need to build one of these sites.

5 Now, I quite agree that the time that you  
6 spend on hearings and so on is a flexible amount, but  
7 what these witnesses can help us with is what is the  
8 sort of time it takes to put a nuclear plant into  
9 position, into service.

10 MR. HEINTZMAN: Q. Am I correct, Mr.  
11 Penn, that Hydro needs an answer by 1994 in order that  
12 it can make the choices or choice that are set forth on  
13 page 81?

14 MR. B. CAMPBELL: What does my friend --

15 THE CHAIRMAN: Please, Mr. Campbell.

16 MR. PENN: It is quite true that Hydro  
17 would need to start studies around about that time.  
18 Whether it needs permission, whether it is necessary  
19 to remove the nuclear moratorium to even start thinking  
20 about these things, I have no idea. I have assumed  
21 that that is not the case.

22 MR. HEINTZMAN: Q. You have assumed that  
23 is the case. You have assumed that it is the case on  
24 page 78 and on page 74, that somebody is going to have  
25 to say, okay, you have the green light to proceed with

1 nuclear generation.

2 MR. PENN: A. Well, I --

3 MR. B. CAMPBELL: Mr. Chairman, with  
4 respect, my friend is ignoring the fact that Mr. Penn  
5 has corrected that entry on page 78. He has corrected  
6 it twice now. He has been quite explicit about it and  
7 he has apologized to the Board.

8 MR. HEINTZMAN: Well, perhaps we can  
9 de-excite Mr. Campbell by forgetting about the nuclear  
10 moratorium.

11 Q. Whatever you want to call it, Hydro  
12 needs a green light for the commencement of the  
13 definition stage by 1994 because each of the times on  
14 page 81 include the definition phase and the  
15 acquisition phase; right?

16 MR. PENN: A. I agree with you that  
17 there is one option, the 4 by 881 on a new site where  
18 we would have to start thinking about the studies in  
19 very late 1994.

20 Q. And if you wanted to go with the  
21 BWR-90 at 4-3/4 years you would have to know three  
22 months later?

23 A. That is not my record.

24 Q. I'm sorry?

25 A. The BWR-90?

1 Q. Yes, that is 4-3/4 years -- sorry,  
2 14-3/4, 177 months as opposed to 180 months. There is  
3 only three months' difference.

4 A. I agree with you that if BWR-90  
5 happened to be an option of interest, then yes, we  
6 would, but this table merely provides the  
7 characteristics of all these options for the future.  
8 It doesn't necessarily say that we are going to  
9 consider every one of them, and, in fact, I am certain  
10 we won't.

11 Q. Well, if you are going to consider  
12 the one that you were considering at the time it was  
13 cancelled - namely, CANDU "A" - and if you are going to  
14 consider it on a new site, then you have to know by  
15 1994; right?

16 A. Very late 1994.

17 Q. Very late 1994, all right.

18 A. That is, assuming that the 15 years,  
19 that I have already explained to you has very many  
20 reasons for improvement, was to be conservatively taken  
21 as that is what we had to do.

22 Q. Well --

23 A. I don't think it is necessarily true  
24 that Ontario Hydro would start these studies in late  
25 1994. It may look at the issue and say there is

1 different new sites around the province.

2 Q. But those are all the sort of  
3 questions and issues --

4 A. These are judgments.

5 Q. Exactly. And those are the kinds of  
6 questions and judgments that Ontario Hydro will go  
7 through when it is given the green light to do so;  
8 right?

9 A. When our board of directors on the  
10 basis of need feels that it is necessary to proceed,  
11 then we will proceed.

12 Q. Yes. And you will tell them that you  
13 need these kind of lead times as a conservative  
14 estimate in order to maximize your alternatives; right?

15 A. I am not sure I understand what you  
16 mean by maximize our alternatives.

17 Q. That you will have all the reasonable  
18 alternatives set forth on page 81 - which are all  
19 reasonable, I take it?

20 A. Well, this is only my own personal  
21 view, but I don't think that the Environmental  
22 Assessment Act requires us to consider all possible  
23 alternatives all over the world. It would require us  
24 to consider reasonable alternatives.

25 THE CHAIRMAN: No, no. I think you may

1 have misunderstood Mr. Heintzman's question.

2 I think Mr. Heintzman is asking you, in  
3 order to plan to the maximum effect you should be able  
4 to consider all reasonable alternatives, and so you  
5 have to take in his view the alternative with the  
6 longest lead time as the benchmark for when you should  
7 be making that consideration.

8 Now, I don't know whether you agree with  
9 that or not, but that seems to be the question he is  
10 asking you.

11 MR. PENN: I think I have tried to answer  
12 it, Mr. Chairman, by saying that the very longest lead  
13 time from the very start of the definition phase  
14 studies is a multi-unit, 4 by 881 station on a new site  
15 where we have conservatively assumed it would take 15  
16 years. That backs us off to October, 1994 by my  
17 reckoning.

18 But there are all sorts of other options.  
19 The CANDU 6 --

20 THE CHAIRMAN: No, I think I understand  
21 that, but I the question I would like to know the  
22 answer to is, if you going to make these kinds of  
23 decisions, isn't it reasonable that you should be able  
24 to not constrain yourself from selecting an option  
25 because you haven't got enough lead time?



1 MR. PENN: I think what you have  
2 suggested is quite right, sir.

3 MR. HEINTZMAN: Q. And therefore, as the  
4 Chairman has said, you should use as the benchmark the  
5 longest time of one of the options that you are going  
6 to consider?

7 MR. PENN: A. The difficulty I have, Mr.  
8 Heintzman, is that it presumes and it speculates that  
9 indeed we need a block of capacity starting to come  
10 in-service round about 2009 or 2010 as large as 3,500  
11 megawatts.

12 I have agreed with the Chairman that that  
13 is the longest lead time, but, quite frankly, I don't  
14 know since I am not the planner that we do need a block  
15 of capacity that size.

16 Q. It doesn't necessarily mean that  
17 Hydro will build a 4 times 881 megawatt, but it might  
18 build it; isn't that correct? That is a possibility,  
19 and, in fact, you have recorded it?

20 A. I have recorded it here because it is  
21 a nuclear option that is possible for the future, given  
22 the whole range of circumstances that might exist.

23 Q. Yes.

24 A. All I have just been trying to point  
25 out to you is that it is not necessarily that we would

1 include every one of these options because they may  
2 either be too small or too big.

3 Q. But you have already agreed with the  
4 Chairman that there is no sensible reason for  
5 constraining Ontario Hydro's choices so that it cannot  
6 select one of them that it would otherwise select; you  
7 have agreed with that?

8 A. We certainly wouldn't want to be  
9 constrained at not making a choice which we needed.

10 Q. And one of the choices that you have  
11 on page 81 is a 4 times 881 megawatt plant?

12 A. Yes, it is.

13 Q. And, in fact, it is one of them that  
14 you were pursuing as of 1990?

15 A. Yes.

16 Q. So it is not as though it is beyond  
17 the realm of possibility. Of all of them on page 81 it  
18 is the only one that you are actively pursuing either  
19 on an existing site or a new site?

20 A. Yes, and for very good reasons.

21 Q. So may I then take it that you agree  
22 with what the Chairman said to you; namely, that there  
23 is no sensible reason for having an approval, having a  
24 green light which excludes that option?

25 MR. B. CAMPBELL: Mr. Chairman, I

1 hesitate to get to my feet again, but I think this in  
2 my submission is quite an unfair question to put to Mr.  
3 Penn.

4           Anyone can do the math and that is what  
5 we have done, but the choices as to the tradeoffs that  
6 have to be made and commencing work, the timing of  
7 that, the considerations that go into that, Mr. Penn  
8 has said several times involve a range of  
9 considerations, and those decisions aren't as simple as  
10 do the math, start here. Nobody has ever said that.

11           The people that are going to deal with  
12 those kinds of considerations as to where the work  
13 needs to start, given a certain set of circumstances,  
14 and what work of what type needs to start, that is the  
15 matter that is going to be addressed in Panel 10.

16           That is clearly one of the matters that  
17 is spoken to directly in the Update, and Mr. Penn  
18 cannot speak to all of those other considerations that  
19 went into it. He can do the math, but when it comes to  
20 a planning conclusion based on doing the math, that is  
21 a horse of an entirely different colour, and I do  
22 object to being forced into the position where we are  
23 in effect doing Panel 10 all the way through.

24           We have witnesses here who cannot speak  
25 to those Panel 10 matters with authority, and we have

1 witnesses who are coming to do just that.

2 THE CHAIRMAN: All right. Sorry, Mr.  
3 Heintzman.

4 MR. HEINTZMAN: I object strenuously to  
5 my friend interjecting. This has got nothing to do  
6 with choices. This has got solely to do with when a  
7 decision must be made to proceed with one of these  
8 options on page 81 when we already have a lead time  
9 analysis from these witnesses on a CANDU 6, and I take  
10 strong exception to my friend interfering with this  
11 examination repeatedly.

12 THE CHAIRMAN: Speaking for myself, I  
13 would think that somebody who was in the nuclear  
14 generation expertise would want to be in a position to  
15 recommend whatever he thought was feasible and useful  
16 to meet the needs that he had been told, and therefore,  
17 would want to have the widest possible choice to do  
18 that.

19 But I think two things I would like to  
20 say. One is I think it is time we had a break, and  
21 two, I think I have heard about all - speaking for  
22 myself - heard about all I need to hear about this  
23 particular exchange. [Laughter]

24 THE REGISTRAR: This hearing will take a  
25 15-minute recess.

1 ---Recess at 3:50 p.m.

2 ---On resuming at 4:05 p.m.

3 THE REGISTRAR: Please come to order.

4 This hearing is again in session. Be seated, please.

5 MR. HEINTZMAN: Thank you, Mr. Chairman.

6 Q. Mr. Penn, I just have one further  
7 area of questioning and that is the present  
8 international situation with respect to nuclear  
9 development, you gave some evidence in chief and  
10 earlier in my cross-examination, Mr. Penn, and if I  
11 could just ask you a few questions about that. I have  
12 given you a couple of articles, I don't require them to  
13 be filed. If the Panel would like them filed, just if  
14 I can go through it and if we require them to be filed  
15 then we will do so.

16 But just to deal with the French  
17 situation, I have given you one article that indicates  
18 that that Electricite du France is presently applying  
19 for permission to build two more 1,400 megawatt class  
20 PWRs at Penly, and is about to submit an application to  
21 build two more at Flamanville, in Normandy. Would you  
22 accept that as good information or...

23 MR. PENN: A. Well, I think in my direct  
24 evidence that I indicated that from my discussions this  
25 January with senior officials EDF, that they do plan to



1 build up to five more units for in-service around about  
2 1999 to 2002 or so.

3 Q. So that would be consistent?

4 A. Yes.

5 Q. And then just the Japanese situation,  
6 you will see I have given you an article indicating  
7 that they have what is described as probably the  
8 world's largest construction program in terms of  
9 planned new nuclear facilities, would you agree with  
10 that assessment?

11 A. Yes. Again, in my direct evidence I  
12 indicated that Tokyo Electric have just committed to  
13 build two boiling water reactors, that's through a  
14 licence agreement with General Electric U.S. and with  
15 Toshiba and Hitachi in Japan. It's my understanding  
16 that Kansai Electric will order two pressurized water  
17 reactors before the end this year. And of course, as  
18 the article you handed out indicated, through  
19 collaboration between Atomic Energy of Canada Limited  
20 and the Electric Power Development Corporation of  
21 Tokyo, which is a government-owned utility, there are  
22 plans by the Japanese to build a 600 megawatt or so  
23 type of pressurized heavy water reactor in northern  
24 Honshu Island.

25 Q. And, finally, in the United States

1 one of the articles I have given to you indicates, and  
2 I think it is well-known, that there is a \$200 million  
3 engineering program going on in the United States, and  
4 I think you perhaps referred to this in chief, between  
5 government, industry and EPRI. Is that is the same  
6 program that's referred to in this article?

7 A. Yes. I noted that through NPOC, the  
8 Nuclear Power Oversight Committee, that has membership  
9 of chief executive officers of the major utilities in  
10 the United States that are nuclear and the major  
11 vendors, and utilizing the services of the Electric  
12 Power Research Institute, there is actually  
13 expenditures expected up to 500 million, 300 million of  
14 which is associated with the upfront licensing with the  
15 regulatory authority, USNRC, and the other amount of  
16 money provided by various utilities in the United  
17 States and around the world, in other countries is  
18 associated with the completion of first of a kind  
19 engineering of these ALWRs that I have described in my  
20 direct evidence.

21 MR. HEINTZMAN: Fine. Thank you very  
22 much. I am going to turn matters over to Mr. Hamer, if  
23 I may.

24 MR. HAMER: Panel, my name is David  
25 Hamer, and I have to follow a hard act.

1                   Mr. Chairman, I have provided the panel  
2 members with two tabbed volumes.

3                   I believe, Ms. Findlay, you will find  
4 that the panel members have those volumes.

5                   I would ask that the Registrar pass the  
6 Board members their copies of those volumes.

7                   THE CHAIRMAN: Do you want the volumes  
8 marked as an exhibit? Is that what you would like?

9                   MR. HAMER: I am indifferent, Mr.  
10 Chairman?

11                   THE CHAIRMAN: Are they all  
12 interrogatories?

13                   MR. HAMER: Some are interrogatories,  
14 some are excerpts from existing exhibits, and I can  
15 identify those as we go along, and some are new  
16 documents.

17                   THE CHAIRMAN: When we get to a new  
18 document we will give it an exhibit number.

19                   MR. HAMER: I wonder if you want to give  
20 a separate number to the book, just so we can keep  
21 track of it. I don't particularly care one way or the  
22 other, whatever is most convenient for the Board.

23                   THE CHAIRMAN: You have two books here?

24                   MR. HAMER: Yes, and one is marked Volume  
25 2 and one is marked Volume 3, and Mr. Heintzman's was

1 Volume 1.

2 THE CHAIRMAN: If we get a new document  
3 we will give it a new number, but we don't give the  
4 books a new number.

5 MR. HAMER: Thank you, Mr. Chairman.

6 CROSS-EXAMINATION BY MR. HAMER:

7 Q. Panel, am I correct that those who  
8 cannot tell me anything about Exhibit 507 include Mr.  
9 Daly and Mr. Penn?

10 MR. PENN: A. Other than general  
11 comments, you are correct.

12 Q. You would be able to tell us  
13 something about plant safety, Mr. Penn?

14 A. I think Mr. King is the expert there.

15 Q. All right.

16 And Mr. Daly?

17 MR. DALY: A. I am essentially in the  
18 same position as Mr. Penn.

19 Q. All right. And, Mr. King, am I  
20 correct in understanding that you would not be able to  
21 tell me about the health effects portions of Exhibit  
22 507 from your earlier testimony?

23 MR. KING: A. I would prefer to restrict  
24 my comments to the radiological accidental health  
25 effects which was the subject of my evidence in chief.

1 Q. So that you can tell us about the  
2 effects of radiation?

3 A. No, the health effects of radiation,  
4 that's Dr. Whillans, but the accidental risks, the  
5 risks from accidents, radiological risks, which was the  
6 subject of my evidence in chief, I would be prepared to  
7 speak to those.

8 Q. By radiological risks, you mean the  
9 risk of emitting radiation from a station through  
10 accident?

11 A. That's correct.

12 Q. Mr. Johansen, you will be able to  
13 tell us a good deal about the environmental effects of  
14 nuclear generation and something about the health  
15 effects; have I understood that correctly?

16 MR. JOHANSEN: A. The health effects I  
17 would qualify. I am not quite sure what you expect  
18 from me in that area.

19 Q. Well, I will try and you let you  
20 know.

21 A. Radiological health effects, to be  
22 clear, would be Dr. Whillans domain.

23 Were you referring to non-radiological  
24 health effects?

25 Q. If I am understanding you correctly



1 then, you can't tell us about the radiological effects  
2 on the environment, or can you, of nuclear generation?

3 A. On the environment, yes, that I am  
4 prepared to talk about.

5 Q. But not on human kind?

6 A. That's right.

7 Q. And Dr. Whillans can tell us about  
8 the health effects but not the effects on the natural  
9 environment; is that correct?

10 DR. WHILLANS: A. That's correct.

11 Q. Now, who can tell me who wrote  
12 chapter 1 of Exhibit 507?

13 A. I think we told Mr. Heintzman that  
14 the report was prepared by a committee, and I don't  
15 think there is a person to my knowledge who wrote  
16 chapter 1.

17 Q. May I ask if there is anyone on this  
18 panel who was on that committee?

19 MR. JOHANSEN: A. It wasn't a formal  
20 committee but certainly I participated in some of their  
21 meetings, probably not all of them.

22 Q. But if I want to ask about chapter 1  
23 I should ask you, Dr. Whillans?

24 DR. WHILLANS: A. Chapter one is the  
25 introduction?

1 Q. Yes.

2 A. The report outline?

3 Q. Yes.

4 A. You can ask me as well as anyone, I  
5 think.

6 Q. You will be able to answer?

7 A. I don't know.

8 THE CHAIRMAN: Wait until he gets the  
9 question before he knows whether he can answer that or  
10 not.

11 MR. KING: I think we are prepared to  
12 answer questions on a subject matter rather than on a  
13 chapter matter. There may be more than one of us who  
14 will speak to a certain chapter.

15 MR. HAMER: Q. Dr. Whillans, were you  
16 also on the informal committee that created chapter 5  
17 of 507, entitled Impacts on Human Health?

18 DR. WHILLANS: A. We talked quite a lot  
19 about chapter 5 with Mr. Heintzman and --

20 Q. We are going to talk a lot more, I  
21 can assure you.

22 A. Well, I think what we said was that  
23 it was created by a group of people.

24 Q. Were you a member of that group?

25 A. Well, I certainly came to some

1 meetings where that chapter, amongst others, were  
2 discussed. But I mean, I can tell you I did not write  
3 any of the words in that chapter.

4 Q. Anyone else?

5 MR. JOHANSEN: A. Perhaps I can just  
6 clarify. As I said before the coordinating author of  
7 the document was from my department. I think it would  
8 be fair to say that that the role that I had, that Dr.  
9 Whillans had, and that I believe Mr. King as well,  
10 was --

11 Q. Chapter 5?

12 A. The document as a whole, was in a  
13 review capacity. Information that we personally had  
14 developed over the years for some other purpose may  
15 have been used by the team, but we did not actually  
16 have a role in writing this document.

17 Q. Does that apply to you, too, Dr.  
18 Whillans, you didn't have a role in writing chapter 5?

19 DR. WHILLANS: A. I did largely write  
20 appendix 2. Appendix 2 was used by the people who  
21 constructed chapter 5. But beyond that, no, and beyond  
22 the review that Mr. Heintzman referred to.

23 Q. So you, Dr. Whillans, reviewed  
24 chapter 5 before Exhibit 507 was issued?

25 A. I reviewed the whole document before

1 it was issued.

2 Q. And in particular chapter 5 entitled  
3 Impacts on Human Health?

4 A. Yes.

5 Q. As did you, Mr. Johansen?

6 MR. JOHANSEN: A. I focused my review on  
7 chapter 4, but I did look at chapter 5 as well.

8 Q. All right. What was the name of that  
9 person, the coordinating author? Is that the term?

10 A. Well, it is just a general term that  
11 I used.

12 Q. Who was the coordinating author?

13 A. A person in my department who is not  
14 on any of the witness panels, I might add.

15 Q. What is that person's name?

16 A. Louise Grondin.

17 Q. Could you spell that, please?

18 A. Louise, the common spelling.  
19 Grondin, G-R-O-N-D-I-N.

20 Q. And she is was the coordinating  
21 author for the whole of Exhibit 507 or the just chapter  
22 5?

23 A. The whole document.

24 Q. And she is employed with Ontario  
25 Hydro?

1 A. Yes.

2 Q. What is her position there as of  
3 today?

4 A. She is an environmental studies  
5 specialist in the planning and programs unit which I  
6 believe I referred to at the beginning of  
7 cross-examination when asked about my personal role in  
8 the preparation of the DSP, the EA, and so on.

9 Q. Now, Mr. King, did you have a role in  
10 the writing of chapter 5 of Exhibit 507?

11 A. No, I did.

12 MR. KING: A. No, I did not. They are  
13 parts of chapter 5 dealing with the public accidental  
14 radiological risks which I would have reviewed when I  
15 was on the circulation, review circulation as referred  
16 to by Dr. Whillans.

17 Q. What portions of chapter 5 were  
18 those?

19 A. They would be some materials on the  
20 last paragraph on page 518 and the conclusion of that  
21 paragraph on 519. I believe that's the majority of the  
22 material which is pertinent to my domain.

23 Q. And, Mr. Johansen, would Ms. Grondin  
24 have been responsible herself or through staff for  
25 conducting the literature review which produced the



1 tables at the back of chapter 5 setting out the  
2 fatality risks for various aspects of the nuclear fuel  
3 cycle?

4 MR. JOHANSEN: A. No, she put it  
5 together, I suppose. She was of the chief editor,  
6 perhaps that is a better way of putting it.

7 The risk data that was gathered from the  
8 literature and factored up or down based on Ontario  
9 Hydro's particular circumstances, that was an effort  
10 done by other members of the active team.

11 Q. What were their names?

12 A. These were both from the nuclear  
13 safety department. I believe I am correct, and again,  
14 neither is a member of any of the panels that appear  
15 before you, one person I believe that would have had  
16 some input from my understanding would have been Mr.  
17 Ken Donnelly.

18 Q. And the other?

19 A. And the other would have been Ms.  
20 Theo Kemp.

21 Q. What are their positions?

22 THE CHAIRMAN: Could you give those names  
23 clearly. I think some of the people haven't heard the  
24 member.

25 MR. HAMER: Q. There was Ken Donnelly

1 and Theo Kemp; is that correct, Mr. Johansen?

2 MR. JOHANSEN: A. That's correct.

3 Q. What are their positions in the  
4 nuclear safety department or division?

5 MR. KING: A. Given that they are in the  
6 same department as I, Mr. Donnelly is a supervising  
7 design engineer. He is on special assignment, I think  
8 his title is just special assignment right now. He is  
9 dealing with the safety and licensing of auxiliary fuel  
10 facilities, but his permanent home -- he is away from  
11 that on assignment.

12 Ms. Kemp, she works in that auxiliary  
13 fuels unit as nuclear design engineer specialist, I  
14 believe would be her official title.

15 Q. And they both come from your  
16 department, Mr. King?

17 A. Yes.

18 Q. Now, I want to go over some of the  
19 conclusions of previous inquiries into nuclear safety,  
20 and I believe you referred to some of them in your  
21 examination in chief.

22 I am correct that as of the late 1970s  
23 the most recent report would have been the Porter  
24 Commission report; is that correct? Mr. King, perhaps  
25 could you answer that. I am referring to Ontario at

1       this point.

2                   A. Well, the Porter Commission did look  
3       at -- I believe they issued an interim report on  
4       safety, I forget the exact year, '79, perhaps.

5                   Q. Something like that, yes.

6                   And next came the Ontario Legislature  
7       Select Committee in the early 1980s; is that correct?

8                   A. I would like to clarify that. The  
9       Royal Commission on Electric Power Planning, which is  
10      the full name for the Porter Commission, dealt with  
11      many more subjects than just safety.

12                  Q. Right.

13      [4:28 p.m.]

14                  A. As I indicated in my evidence in  
15      chief, I believe it's the 1980 Report of the Select  
16      Committee of Ontario Hydro Legislature on Safety.

17                  Q. And next came Dr. Hare's commission,  
18      the Ontario Nuclear Safety Review, which reported in  
19      1988; is that correct?

20                  A. Yes.

21                  Q. And Mr. King or any other Panel  
22      member, are you familiar with the general outcome of  
23      the Sizewell "B" Commission conducted in the United  
24      Kingdom by Sir Frank Laycroft?

25                  A. Frank Layfield, I believe.

1 Q. Layfield, you are right.

2 A. I am just familiar with it to the  
3 extent that it was a very long, thorough examination  
4 which resulted in the approval of the Sizewell "B"  
5 reactor to proceed. I have not read the report itself.

6 Q. You are aware, however, that it  
7 considered safety matters obviously for an approval of  
8 a nuclear station?

9 A. Yes.

10 Q. And again, are you familiar with the  
11 outcome in general terms of the Hinkley Point inquiry  
12 conducted by Mr. Michael Barnes and reporting in 1990?

13 A. I am not familiar with that report at  
14 all.

15 Q. Never heard of it?

16 A. Not until I believe you delivered it  
17 to us in the last day or so.

18 Q. All right. And has any other Panel  
19 member ever heard of Hinkley Point in the United  
20 Kingdom?

21 MR. PENN: A. Yes. [Laughter]

22 Q. And, Mr. Penn, I take it you have  
23 heard of the Hinkley Point inquiry conducted by Mr.  
24 Barnes?

25 A. I have only heard of it through my

1 contact with Brian George in the United Kingdom, who is  
2 the project manager of Sizewell "B". I haven't  
3 discussed the details with him.

4 Q. And, Dr. Whillans, are you aware of  
5 the Hinkley Point inquiry having been carried out and  
6 reported?

7 DR. WHILLANS: A. Only to the extent of  
8 what you gave me this morning.

9 Q. Well, let's leave Hinkley Point out  
10 of my question, then, but can you agree with me, Mr.  
11 King, that as far as you know in the area of nuclear  
12 safety all of those inquiries came to conclusions which  
13 in broad terms were favourable to the safety of nuclear  
14 power generation?

15 MR. KING: A. I think that would be a  
16 good general conclusion.

17 Q. And all of them related to the  
18 nuclear power programs of central, publicly-owned  
19 utilities; correct?

20 A. Well, the reports you have mentioned  
21 just talk about Ontario Hydro and the then CEGB in the  
22 United Kingdom, which was publicly owned at that time.

23 Q. All right. And as far as Ontario is  
24 concerned, then, the Hare Commission report is the most  
25 recent report?



1 A. Yes.

2 Q. And I take it that you would be  
3 familiar with the general conclusions of the Hare  
4 Report, Mr. King?

5 A. I have read the report to the  
6 Minister. I am familiar with that in detail. Some of  
7 the appendices I am less familiar with.

8 Q. But in general terms the Hare Report  
9 is one of the cornerstones upon which Ontario Hydro  
10 relies in this DSP hearing with respect to the safety  
11 of its power reactors?

12 A. I don't know whether I would use the  
13 word cornerstone. I used it as just an example of some  
14 external review that had been performed on our safety  
15 program. That's all.

16 Q. And you were quite content with the  
17 broad conclusions of the Hare Commission, I take it?

18 A. We were happy with the general  
19 conclusion, yes.

20 Q. I would like to look at some excerpts  
21 from the Hare Report, and if you would turn to my book  
22 which is tabbed, and it has got a small notation,  
23 "Volume 2", at the bottom, and at tab 14 we have  
24 excerpts from Volume 1 of the Hare Report.

25 THE CHAIRMAN: Do you have the Hare

1 Report exhibit number in this hearing? You have got  
2 184?

3 MR. HAMER: Yes, it's Exhibit 184.

4 Q. And I would like to turn to -- and  
5 this may be a little bit disjointed, but I am asking  
6 you to turn to page 22, Arabic figures.

7 MR. KING: A. I have got a 21.

8 MR. B. CAMPBELL: I don't have a 22 in my  
9 copy.

10 THE CHAIRMAN: 22 is a box with inquiries  
11 and reports?

12 MR. HAMER: Q. Yes, I think the  
13 photocopier has hit a glitch. Since it is excerpts you  
14 will find page 15 followed by page 22. Do you have  
15 page 15?

16 MR. KING: A. Yes.

17 Q. Then, you have page 22. I simply  
18 direct you to that page as a useful list of the various  
19 reports which Dr. Hare considered in his deliberations,  
20 and we have mentioned some of those: the Porter Report  
21 and the Select Committee, the Sizewell "B" inquiry, and  
22 then some American reports.

23 You are aware that Dr. Hare utilized  
24 those previous reports in his deliberations?

25 A. Well, he has included them in this

1 table. How he used those reports, I am not sure I can  
2 make any general statement on how he used them.

3 Q. All right. You would be aware that  
4 numbers 8 and 9 on his list originated with Ontario  
5 Hydro in part and...is it the Argonne National  
6 Laboratory in the United States?

7 A. Yes, as stated here, that's correct.  
8 It was some work done by both Argonne and Ontario  
9 Hydro.

10 Q. And those reports represented a  
11 partially independent review of Ontario Hydro's safety  
12 analysis, if I understand them correctly, is that so,  
13 in the sense that Ontario Hydro provided data and the  
14 Argonne National Laboratory then did work of its own  
15 using that data?

16 A. Well, I understand that Dr. Hare  
17 contracted with Argonne to perform analysis of a loss  
18 of coolant accident with failure to shut down at  
19 Pickering "A".

20 Argonne, in order to do that analysis,  
21 required some information which it obtained from  
22 Ontario Hydro. It performed independent analysis of a  
23 number of elements in the total accident sequence  
24 chain, and I believe that analysis was also repeated by  
25 Ontario Hydro. So for the important parts of that

1 accident analysis chain there were two independent  
2 parts, two independent people doing the analysis, yes.

3 Q. And we can agree, again in general  
4 terms, that both of those analyses found the outcome  
5 of that accident sequence to be within acceptable  
6 bounds?

7 A. What that analysis showed, if I could  
8 just give a general summary of it, and I should preface  
9 my remarks by saying that this analysis is a very  
10 difficult analysis because it gets into areas where  
11 there are not experiments, et cetera, to fully verify  
12 the codes.

13 But that analysis showed that the peak  
14 pressure following the accident sequence, the peak  
15 pressure in containment that would arise from the  
16 accident would be somewhat over the design pressure for  
17 containment, but as part of this analysis there was an  
18 analysis of the containment response following such an  
19 overpressure, and it was concluded that there would not  
20 be any catastrophic failure of containment.

21 There may be some cracks, but these  
22 cracks would reseal once the pressure was relieved, and  
23 the off-site radiological consequences that were  
24 reported in this analysis did not exceed the dose  
25 limits that the AECB has established for a dual

1 failure.

2 Q. And both of those analyses were  
3 directed, as I understand it, to the Pickering "A"  
4 station by reason that the Pickering "A" station was  
5 the earliest of Ontario Hydro's stations and had only  
6 one fully independent special shutdown system; is that  
7 correct?

8 A. Yes. I believe Dr. Hare was trying  
9 to get some more information to satisfy his concerns  
10 that the situation at Pickering without its two fully  
11 capable shutdown systems was "acceptable".

12 Q. And that indeed was the outcome of  
13 those two analyses?

14 A. Yes, but he has made some other  
15 recommendations in his report.

16 Q. And further work has gone forward as  
17 a result of those recommendations?

18 A. Yes.

19 Q. And have you been involved in some of  
20 that work?

21 A. I am aware of the work.

22 Q. We will come back to some of the  
23 details of Dr. Hare's findings, but, as I understand  
24 it, after Dr. Hare had been appointed by the provincial  
25 government he was given authority, and did in fact



1 undertake, to obtain the assistance of the Royal  
2 Society of Canada; is that correct?

3 A. That's correct.

4 Q. And the Royal Society provided a  
5 panel of three independent reviewers to review his  
6 report in draft and then in a final draft form?

7 A. I believe they reviewed a draft, or I  
8 guess a near to a final version of the report, and I  
9 believe there were some meetings, and I believe the  
10 report was subsequently revised to some extent and then  
11 they reviewed it in final.

12 Q. If we could turn back to the  
13 beginning of my tab 14 we find a letter from the  
14 president of the Royal Society to Dr. Hare, dated March  
15 the 12th of 1988, referring to the terms of reference  
16 for that external review panel; correct?

17 A. Yes.

18 Q. And then overleaf we find the  
19 external reviewers' response or conclusions from their  
20 review, and on the second page of that letter, which is  
21 also dated March the 12th of 1988, they refer to having  
22 reviewed Dr. Hare's report in draft in January of 1988?

23 A. What page are you...?

24 Q. Second page of the Royal Society  
25 letter?

1 A. Okay.

2 Q. Do you see that at the top of the  
3 page?

4 A. Yes. I have that.

5 Q. All right. And then there was a  
6 further meeting in March of 1988, and they say that:

7 During that period we completed our  
8 discussions with the Commissioner.

9 Is that correct?

10 A. Yes, I see that.

11 Q. And then, in the balance of page 2  
12 and over onto page 3 of their letter they outline, do  
13 they not, the various steps that had been taken by Dr.  
14 Hare and his staff in examining the question of the  
15 safety of Ontario Hydro's nuclear reactors?

16 A. Yes, they do.

17 Q. And at the bottom of page 3 and over  
18 onto page 4 they find as follows:

19 The investigation has been performed  
20 with competence and thoroughness.

21 Correct?

22 A. Yes.

23 Q. The recommendations made and opinions  
24 expressed by the Commissioner are soundly  
25 based and are adequately supported.

1 A. That is what it says.

2 Q. Our criticisms of the draft report  
3 have been thoroughly discussed with the  
4 Commissioner and have been satisfactorily  
5 resolved in every respect.

6 A. Yes.

7 Q. And then they go on on page 4:

8 We wish to add to our formal answer  
9 some further conclusions. In our  
10 opinion, high scholarly standards have  
11 been achieved. By this, we mean that all  
12 the relevant information has been  
13 assembled and reviewed with critical  
14 disinterest. The report will, we  
15 consider, serve as an authoritative  
16 document for those interested in nuclear  
17 power operation in Ontario.

18 Correct?

19 A. That is what it says.

20 Q. And I take it that at that time you  
21 would have agreed with those opinions as well to the  
22 extent that your expertise would allow?

23 A. I have no reason, you know, to think  
24 that all these statements aren't appropriate.

25 Q. And they say in their final

1 paragraph:

2 Finally, we have between us had the  
3 opportunity to draft, read or criticize a  
4 substantial number of reports both public  
5 and private. Against that experience we  
6 regard the Ontario Nuclear Safety Review  
7 report as exemplary.

8 And I take it you would agree with that  
9 opinion as well to the extent that your expertise would  
10 allow?

11 A. Well, I assume that they are  
12 referring to other public and private reports of --  
13 well, they don't say what nature of those reports, but  
14 I would assume they would imply that they are reports  
15 of a similar scope, not necessarily in the nuclear  
16 field, but...

17 Q. On scientific and technical matters?

18 A. Scientific, yes. And I would assume  
19 those authors have that experience, and undoubtedly  
20 have more experience than I in that area, and--

21 Q. You would accept their judgment?

22 A. --I defer to their conclusion.

23 Q. All right. And I noticed just as a  
24 point of interest that one of those external reviewers  
25 was, in fact, Sir Frank Layfield, as you point out.

1 A. Yes.

2 Q. All right. And just while we are at  
3 tab 14, and I think you referred in chief to the first  
4 major conclusion of the report. You agreed, I take it,  
5 with that conclusion? This is on the first Roman  
6 numeral page, which doesn't actually have a page number  
7 on it, but it's headed "Minister's Report, Conclusions  
8 and Recommendations".

9 A. I have that page.

10 Q. And you told us in chief that you  
11 agreed with the primary conclusion that:

12 The Ontario Hydro reactors are being  
13 operated safely and at high standards of  
14 technical performance. No significant  
15 adverse impact has been detected in  
16 either the work force or the public.

17 And I take it you agreed with that  
18 conclusion at the time and you continue to regard that  
19 as being a valid conclusion today?

20 A. Yes, I read that. I, in fact, read  
21 that exact clause in my evidence in chief, and I do  
22 believe that is a valid statement, then and now.

23 Q. And a statement, to conclude the  
24 description of his major conclusion, is that:

25 The risk of accidents serious enough



1 to affect the public adversely can never  
2 be zero but is very remote.

3 And you would accept that today as well?

4 A. I would.

5 Q. I have placed some excerpts from  
6 Exhibit 507 at tab 8 of this book, Mr. Chairman.

7 And I have some questions I believe for  
8 you, Mr. King, on the first page in my excerpt there,  
9 which is 1-3 of Exhibit 507. Do you have that?

10 A. Yes, I do.

11 Q. And, Dr. Whillans, feel free to chime  
12 in, if you wish. I believe it was you who spoke to  
13 this table in chief, but I will stay with Mr. King for  
14 the moment.

15 I want to attempt to set in perspective  
16 the average annual dose of ionizing radiation that a  
17 member of the public can expect as a result of the  
18 operation of Ontario Hydro's nuclear generating system.  
19 We see under the heading "Other" the point:

20 Occupational nuclear power, less than  
21 0.01 millisieverts.

22 Is that correct?

23 [4:45 p.m.]

24 A. That's correct.

25 Q. And that refers to the Ontario Hydro

1 workers who are exposed to minute doses of radiation?

2 A. Since this was Dr. Whillans who  
3 introduced all this, I think that I would refer it to  
4 him.

5 Q. Over to you.

6 DR. WHILLANS: A. This table is a little  
7 different than from what I used in my evidence.

8 Sorry, could you repeat the question?

9 Q. Yes. Under the heading "Other" at  
10 the bottom of figure 1.1 we have an entry Occupational  
11 Nuclear Power and then the dose entry for that is less  
12 than 0.01 millisieverts; correct?

13 A. That's what it says.

14 Q. Do you disagree with that as being  
15 the average annual effective dose to be expected by  
16 members of the public who are in radiation occupations?

17 A. I am hesitating because of course the  
18 numbers I gave for nuclear workers is higher than this.

19 Can I just refer to the text?

20 Q. Certainly.

21 I will tell you where I am heading. I  
22 just want to get the millisievert figure that  
23 represents the fact that we have nuclear generating  
24 stations operating, and I took it that it was a  
25 combination of the occupational entry and the nuclear

1 fuel cycle entry.

2 DR. CONNELL: Just an interpolation. I  
3 think we should give the units as stated in order that  
4 the transcript be accurate. Millisieverts per annum, I  
5 believe.

6 MR. HAMER: I'm sorry. Thank you.

7 THE CHAIRMAN: Is there a corresponding  
8 chart on 519?

9 MR. HAMER: There is. It seems to have  
10 been collapsed a little bit, combining some categories,  
11 and I wanted to stick with the --

12 THE CHAIRMAN: Do you have a reference to  
13 that, Mr. Hamer?

14 MR. HAMER: I can certainly find it very  
15 quickly, Mr. Chairman.

16 DR. WHILLANS: It's page 28 of 519.

17 THE CHAIRMAN: 28. Thank you.

18 DR. WHILLANS: I think I started to  
19 clarify that the title is average annual effective dose  
20 equivalent of ionizing radiations to a member of the  
21 public, and I was just scanning through the text, but  
22 certainly these numbers would be for members of the  
23 public, and I am not just clear what occupational  
24 nuclear power was meant to imply, but certainly it  
25 would be to members of the public if they were numbers

1 like that.

2 MR. HAMER: Q. Presumably what happens  
3 is that a certain proportion of the members of the  
4 public are engaged in occupations in which they are  
5 involved in nuclear power generation and that's all  
6 worked into this average table for members of the  
7 public.

8 DR. WHILLANS: A. Well, for someone to  
9 be a radiation worker, he has to have a reasonable  
10 probability of exceeding the public dose limits, which  
11 are 5 millisieverts per year. So, an average which  
12 came out as low as this, if that were for workers,  
13 would imply that they are misclassified.

14 Q. Well, it would also imply that not  
15 everybody works at a nuclear station.

16 A. Well then they aren't occupational  
17 nuclear workers, I guess.

18 Q. Right.

19 A. What I should do is look through the  
20 text and see if there was a clarification of what was  
21 meant by occupational nuclear power, but it should not  
22 refer to radiation workers because workers who receive  
23 doses as low as this would not be classified normally  
24 as radiation workers.

25 Q. Would you undertake to check that for

1 me overnight and give me a clarification of that entry,  
2 occupational nuclear power.

3 I can tell you that my point was not to  
4 draw out any discrepancy between the two tables. My  
5 point was to get a figure that we can allocate to  
6 nuclear generation in Ontario from the perspective of a  
7 member of the public, in comparison with other doses  
8 that a member of the public receives.

9 MR. KING: A. It would be my guess that  
10 this table, this figure 1.1, and this is source I am  
11 not sure -- is that Ontario Hydro? I will have to  
12 check to see whether that is an Ontario Hydro source.

13 But I believe it is just a problem with  
14 terminology on the word "occupational". I think they  
15 probably mean a member of the public where we would not  
16 use occupational to mean member of the public.

17 Q. For example, someone working in a  
18 dentist's office. No, they can't mean that.

19 A. I think they were talking about the  
20 releases, normal releases from a nuclear station and  
21 the impact of that on a member of the public.

22 DR. WHILLANS: A. Certainly on page 28  
23 in my evidence I have nuclear power generation without  
24 the qualification "occupational". That refers to, as  
25 the title says, public doses. But I will certainly



1 clarify what was meant in the table.

2 Q. All right. Well, perhaps while we  
3 are on that, Dr. Whillans, on your page 28 is the  
4 nuclear fuel cycle accounted for?

5 A. Yes.

6 Q. That's included in nuclear power --

7 A. That's included in nuclear power  
8 generation, yes.

9 Q. In any event, for present purposes we  
10 can take it that average annual effective doses to  
11 members of the public are either 0.01 or 0.02  
12 millisieverts per annum; is that correct?

13 A. Less than.

14 Q. Less than, right.

15 And by comparison that average member of  
16 the public receives from naturally occurring radon,  
17 it's estimated, 2.0 millisieverts per annum; correct?

18 A. Yes.

19 Q. And am I correct in thinking that one  
20 of the places one receives that dose of naturally  
21 occurring radon the most may be in one's own dwelling  
22 place where one has dug down into the surface of the  
23 earth a very brief space and as a result exposes  
24 oneself to radon which emerges from the earth's crust  
25 in a sense?

1                   A. Yes. I think in my evidence I  
2 mentioned that the radon contribution to natural public  
3 dose is quite variable and depends a great deal on  
4 where you live, how well sealed the house is, and so  
5 forth. So what you say is true but it is very  
6 variable. Some people are exposed to much more than  
7 this, much more.

8                   Q. I appreciate these are averages,  
9 aren't they?

10                  A. Yes.

11                  Q. And an average is never a real  
12 person, it's the sum and division of everybody.

13                  A. Yes. But whereas the average under  
14 internal is not going to vary very much from one  
15 individual to another, I would estimate not more than  
16 25 or 50 per cent. It could easily be a factor of 10  
17 in radon.

18                  Q. And the type of house one lives in  
19 can effect the exposure to naturally occurring radon?

20                  A. Yes.

21                  Q. And the physical containmentability,  
22 if you like, of that house can affect one's exposure to  
23 naturally occurring radon?

24                  A. You mean to the extent that it is  
25 well sealed?

1 Q. Yes.

2 A. Yes.

3 Q. And the location of that house can  
4 affect one's exposure?

5 A. Yes.

6 Q. And, in any event, that exposure, you  
7 will agree with me, is far in excess of the exposure  
8 that one can expect from the presence of nuclear power  
9 stations?

10 A. Yes.

11 Q. And I think you said the range for  
12 radon can be quite high from member of the public to  
13 member of the public?

14 A. Yes.

15 Q. So that simply by moving house one  
16 could either add or remove the effects of having  
17 nuclear power stations present in Ontario?

18 A. That would be one way.

19 Q. Let's go to cosmic radiation. Am I  
20 correct in understanding that one can receive increased  
21 exposure to cosmic radiation simply by reason of  
22 altitude?

23 A. Yes.

24 Q. And, for example, and I think I had a  
25 discussion with you, Mr. Johansen, earlier about this,

1 Dr. Whillans I am sure can answer, if one were to get  
2 into an airplane and fly from Toronto to Vancouver and  
3 back, it's my understanding that that flight is roughly  
4 equivalent in terms of additional radiation exposure to  
5 standing 24 hours a day, seven days a week, for a year  
6 at the boundary fence of one of Ontario Hydro's nuclear  
7 stations.

8 Mr. Johansen, can you confirm that that's  
9 an accurate estimate?

10 MR. JOHANSEN: A. I can't say that it is  
11 an accurate analogy but it's--

12 Q. A fair one?

13 A. --a common one. It's fair.

14 Q. Fair estimate in terms of orders of  
15 magnitude?

16 DR. WHILLANS: A. I wasn't hesitating  
17 because I --

18 Q. I thought you were going to get your  
19 calculator out.

20 A. No.

21 In the first place this boundary fence  
22 individual is not necessarily a critical group, but if  
23 you mean generally speaking, (A), the most highly  
24 exposed as a result of the operation of the station and  
25 compared with again flights, depending on whether it's

1 high altitude or not, they are certainly within the  
2 same range.

3 Q. And indeed one can move to a  
4 different city at a different altitude and live there  
5 for the rest of one's life and expose oneself to a  
6 higher or lower range of annual effective dose far in  
7 excess, the range being far in excess of the average  
8 annual effective dose that one experiences by reason of  
9 the presence of nuclear power reactors?

10 A. It is greater, yes.

11 Q. I'm sorry?

12 A. It is greater, yes.

13 Q. Next is terrestrial radiation, does  
14 that mean radiation naturally being emitted by the  
15 crust of the earth?

16 A. Elements in the earth, yes.

17 Q. And again that can vary depending on  
18 just where one is on the crust of the earth?

19 A. Yes.

20 Q. By plus or minus 60 per cent  
21 according to this table.

22 A. I believe that reference is a Health  
23 and Welfare Canada reference. Certainly other parts of  
24 the world it's much more than that variation.

25 Q. Is the 60 per cent plus or minus



1 valid for Ontario, is that what you are saying?

2 A. I believe it's a Canadian reference,  
3 not just Ontario, but I can check that too, if you  
4 would like.

5 Q. I don't think it is necessary.

6 In terms of order of magnitude, plus or  
7 minus 60 per cent a fair range for Canadians to see in  
8 terms of their exposure to terrestrial emissions of  
9 ionizing radiation?

10 A. Yes.

11 Q. And again 60 per cent of the average  
12 annual effective dose, which is 0.28 millisieverts per  
13 annum, would be something around 0.15, or thereabouts,  
14 millisieverts per annum?

15 A. Yes.

16 Q. And again that range is 15 times the  
17 average annual effective dose that one can expect from  
18 the presence of nuclear power stations?

19 A. On average, yes.

20 MR. HAMER: I can do internal sources of  
21 ionizing this afternoon or tomorrow morning, Mr.  
22 Chairman. That's my last point on this table.

23 THE CHAIRMAN: Why not tomorrow morning.

24 We are adjourned now until ten o'clock  
25 tomorrow morning.

1 THE REGISTRAR: This hearing will adjourn  
2 until ten o'clock tomorrow morning.

3 ---Whereupon the hearing was adjourned at 5:00 p.m., to  
4 be resumed on Wednesday, April 1, 1992, at 10:00  
a.m.







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